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ABSTRACT

This document contains two U.S. Coast Guard self-study pamphlets that provide training in helicopter flight preparation and avionics duties. Each pamphlet consists of a number of lessons that include objectives, information illustrated with line drawings and/or photographs, and self-quizzes with answers. The avionics course covers the following topics: helicopter systems, engine and rotor systems, helicopter transmission and various systems, flight systems, other systems, communication systems, navigation systems, Loran C navigator, flight director systems, electronic flight aids, and avionics crew members' duties. The flight preparation course covers flight preparation, emergencies and extreme environmental condition operations, rescue procedures, and the high-intensity searchlight system. (KC)

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SAR AIRCREW-HH3F AVIONICS

ACH3AV-0442

UNITED STATES COAST GUARD INSTITUTE
U.S. DEPARTMENT OF TRANSPORTATION

DESCRIPTION:

Provides training in flight preparation and avionics dities.

CONTENTS:

HH-3F Avionics
Pamphlet No. A3AV01 (02/84)

HH-3F Flight Preparation
Pamphlet No. A3AF01 (04/86)

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HH-3F AVIONICS

COAST GUARD INSTITUTE
OKLAHOMA CITY

U. S. DEPARTMENT OF TRANSPORTATION
U. S. Coast Guard (02/84)

U. S. Coast Guard Institute
PAMPHLET NO. A3AVO1

HH-3F AVIONICS

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FTS: 749-2138

Questions about this text should be addressed to the Subject Matter Specialist for the Aviation Electronics Technician Rating.

ACKNOWLEDGEMENT

This pamphlet contains original material developed at the Coast Guard Institute and also excerpts from:

USCG Communications Manual	CG-233
HH-3F Maintenance Instructions Manual	T.O.1H-3(H)F-1
HH-3F Flight Manual	T.O.1H-3(H)F-1

The Coast Guard Institute appreciates permission of these sources to use this material which contributes greatly to the effectiveness of this course. No copies or reproduction of the material is authorized without permission of the appropriate source.

NOTICE TO STUDENT

The primary purpose of this self-paced, nonresident training pamphlet is to help you become qualified as an avionicsman on the HH-3F helicopter.

This pamphlet briefly covers the aircraft and aircraft systems; the communications and navigation systems are covered in detail.

IMPORTANT NOTE: This text has been compiled for TRAINING ONLY. It should NOT be used in place of official directives or publications. The text information is current according to the references listed. You should, however, remember that it is your responsibility to keep up with the latest professional information available for your rating. Current information is available in the Coast Guard Enlisted Qualifications Manual (CG-311).

The objectives for each assignment should lead you in the right direction for study purposes. The self-quizzes test your mastery of the objectives. When you complete all the assignments for the course and master each objective, you should have a thorough understanding of the material and should be ready to pass your End-of-Course Test.

REMEMBER -- You must receive a score of 80% or better to pass the End-of-Course Test. You should use your spare time to REVIEW the material before you take the EOCT.

SWE STUDY SUGGESTION: Servicewide exam questions for your rate and pay grade are based on the Professional and Military Requirements sections of the Enlisted Qualifications Manual (CG-311). If you use the references from this text and consult the Enlisted Qualifications Manual, you should have good information for review when you prepare for your servicewide exam. However, this course covers only a few of the qualifications tested on the SWE.

This course is only one part of the total Coast Guard training program. By its very nature, it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire for accomplishment are also necessary to round out a successful training program.

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HOW TO STUDY THIS COURSE

You can remember more of what you read if you .....

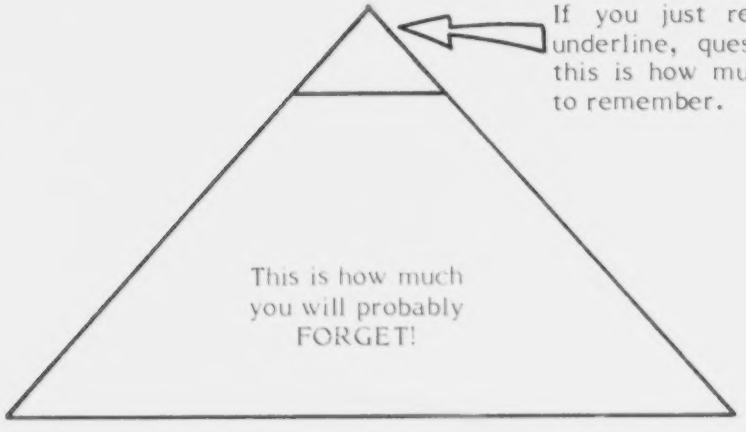
1. "Look over" the reading assignment first. Read the objectives and section headings, and look at the pictures. This gives you an idea of what to expect in the reading assignment and helps you understand the objectives.

2. Question the reading material. Ask yourself questions about a heading or a picture to help you remember what you read.

3. Note points to review later. Don't just run your eyes over a page. Underline important facts and make notes in the margin.

4. Close your pamphlet and repeat important points out loud. Discuss the reading assignment with someone if possible. This helps you recall information for a quiz or end-of-course test.

5. Review your underlined material, notes, quizzes, and objectives. This also helps you remember what you read.


If you just read and do NOT underline, question, or review, this is how much you are likely to remember.
This is how much you will probably FORGET!

FAA AAC 80-3513

HH-3F HELICOPTER SYSTEMS

Reading Assignment:
Pages 1-1 through 1-11.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the HH-3F helicopter's general characteristics, and dimensions.

HELICOPTER FAMILIARIZATION

The helicopter manufactured by Sikorsky Aircraft, Division of United Aircraft Corporation, Stratford, Connecticut, is equipped with a single main rotor, twin engines rated at 1,500 shp each, a fully retractable tricycle landing gear, amphibious capabilities, and hydraulically operated aft ramp that may be opened in flight, on the ground, or on water. The helicopter may be used as a general purpose vehicle to locate, recover, and render assistance to persons in distress. In addition, it may be used for logistic support, reconnaissance, and general utility. The maximum span with the main rotor blades rotating is 62 feet. The maximum length of the helicopter with the rotor blades extended is 73 feet, 1½ inches. The height of the highest point of the helicopter (tail rotor) is 18 feet, 2½ inches. You may become familiar with the configuration of the helicopter by referring to the exterior and interior general arrangement illustraions. (Figures 1-1 and 1-2.) The helicopter's maximum gross weight is 22,050 pounds.

The fuselage is composed of the cockpit, the upper fuselage, the aft fuselage, the pylon, and the lower fuselage. The upper fuselage section contains the cargo compartment, the engine, transmission, and APU compartments. The aft fuselage extends from the cabin to the pylon. The lower fuselage contains four fuel tanks and an electronics rack in the forward section. Sponsons are mounted on each side of the lower fuselage. The pylon is attached to the rear of the aft fuselage. A horizontal stabilizer is mounted on the upper right side of the pylon. The intermediate gear box is installed in the lower portion of the pylon with a shaft extending upward to the tail rotor gear box at the top of the pylon. The five-bladed tail rotor is splined to the tail rotor gear box.

The cockpit provides side-by-side seating for the pilot and copilot, with the pilot on the right side. To the rear of the cockpit is the cabin. Access between the cockpit and the cabin may be used in flight. A folding jump seat is provided in the cockpit entry. A sliding cargo door is located on the right side of the forward end of the cabin. An 8-foot ramp is located at the rear of the cabin. The cabin accommodates two crewmen and six passengers. Two large windows, located in the forward cabin, will be used as search stations. Swivel-type crewman's seats are located adjacent to the search stations. Two electronics racks are located in the cabin; one immediately aft of the copilot and one in the aft portion of the cabin. A folding-type navigator's table is mounted on the electronics rack aft of the copilot and forward of the left crewman's seat. Structural provisions are made for 14 additional passenger seats and 15 USAF pole-type litters. The cabin is 6.6 feet wide, 6 feet high, and 26 feet 2.5 inches long. Eight feet of the length is ramp area. The cabin is equipped with tie-down rings for transportation of cargo. A 600-pound capacity hydraulic rescue hoist with approximately 240 feet of usable cable is suspended on a fixed truss over the cargo door.

Two gas turbine engines are mounted side by side in the engine compartment, located above the forward portion of the cabin. The engine drive shafts extend aft into the main gear box, located in the transmission compartment. The main rotor assembly, to which the five rotor blades are attached, is splined to the main gear box drive shaft. The APU,

located aft of the main gear box, is capable of driving the main gear box accessory section and is used for engine starting and checkout of systems. A removable deflector is installed to reduce the possibility of foreign object damage to the engines.

The HH-3F has three separate hydraulic systems.

DIMENSIONS

Length	
Maximum main and tail rotor blades extended	73 feet 1½ inches
Minimum main and tail rotor blades removed	57 feet 3.53 inches
Height	
Maximum to top of tail rotor blade - vertical static	18 feet 2½ inches
Kneeled	20 feet 3½ inches
Tail rotor diameter	10 feet 7 inches
Minimum tail rotor blades removed	16 feet 1 inch
Width	
Minimum main rotor blades removed	17 feet 4 inches
Main rotor diameter	62 feet 0 inches
Minimum Main Rotor Ground Clearance (Tip clearance - forward section)	
Static	10 feet 1 inch
Kneeled	7 feet 4 inches
Tail Rotor Ground Clearance	
Static	7 feet 7½ inches
Kneeled	9 feet 9½ inches
Tail Pylon Ground Clearance	
Static	6 feet 5 inches
Kneeled	8 feet 0 inches
Main landing gear tread	13 feet 4 inches

CABIN EQUIPMENT

The cabin (figure 1-3) located from station 137.0 to station 379.5, is capable of carrying cargo, personnel, litters, and wheeled vehicles. The impact and wear-resistant cabin floor has a positive non-skid surface for personnel footing, and skid strips to facilitate the movement of cargo and provide floor protection. The cabin floor is divided into six sections and is capable of sustaining static loads of 200 pounds per square foot. Tiedown fittings, rated at 2,500 pounds, are installed on the cabin floor to facilitate cargo tiedown, and are provided with fittings that serve as troop-seat and litter attachment points. The cabin contains a personnel door and a ramp, both of which may be used for loading personnel and cargo. When loading the helicopter, refer to T.O. 1-1B-40, Handbook of Weight and Balance Data.

CARGO LOADING STATIONS

The cabin is divided into marked cg stations between fuselage stations 150 and 375. Cargo loading scales, corresponding to these marked stations, are provided on the load adjuster. The cg loading stations are marked at eye level for easy reference.

CABIN FLOOR

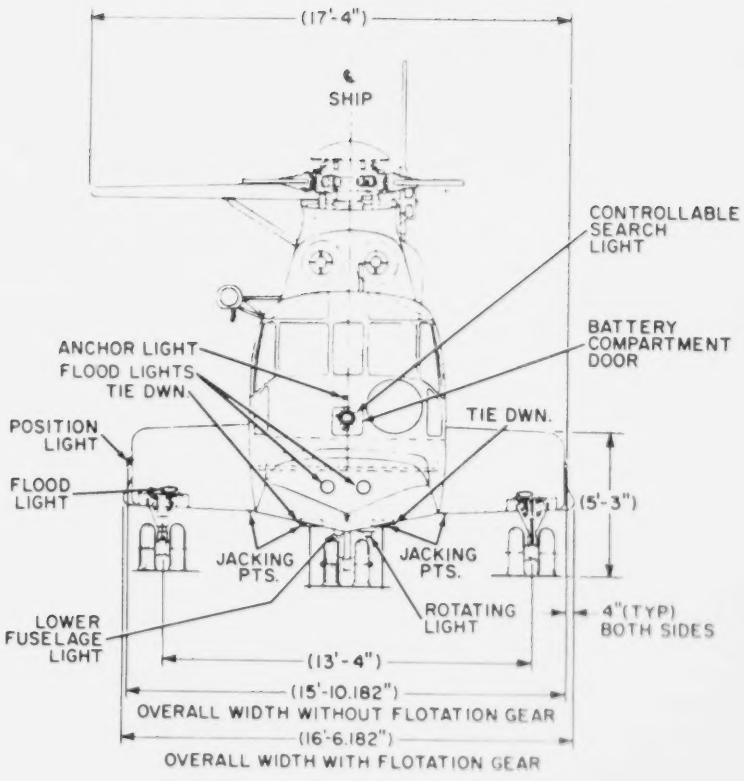
The cabin floor, made of aluminum foil honeycomb cores sandwiched between alloy skins of various gauges, is supported by transverse bulkheads and beams. The cabin floor is approximately 310.5 inches long and 76 inches wide. The forward ramp forms the last 68 inches of horizontal floor. The floor has a positive non-skid surface. Three rows of low friction longitudinal skid strips are installed on top of the cabin floor to provide floor protection and facilitate cargo handling. The cabin floor area is designed to support a maximum load of 200 pounds per square foot; however, higher weights may be carried if shoring is used to distribute the weight over a larger area.

TIEDOWN FITTINGS

The type of tiedown fitting (figure 1-4) used is the combination cargo restraint and lug for troop seat and litter floor attachments. The recessed tiedown fittings have a 2,500-pound restraint capability. The 2,500-pound tiedown fittings are used to secure cargo, litter support straps, troop seat legs, and the crewman's safety harness.

TIEDOWN DEVICES

Various types of tiedown devices may be used for securing cargo. One type is a turnbuckle arrangement for tightening the tiedown chains, another is a webbed type strap with hooks for attaching to tiedown fittings.


(17'-4")
SHIP
CONTROLLABLE SEARCH LIGHT
BATTERY COMPARTMENT DOOR
ANCHOR LIGHT
FLOOD LIGHTS
TIE DWN
TIE DWN.
POSITION LIGHT
FLOOD LIGHT
(5'-3")
JACKING PTS.
JACKING PTS.
ROTATING LIGHT
4"(TYP) BOTH SIDES
LOWER FUSELAGE LIGHT
(13'-4")
(15'-10.182")
OVERALL WIDTH WITHOUT FLOTATION GEAR
(16'-6.182")
OVERALL WIDTH WITH FLOTATION GEAR

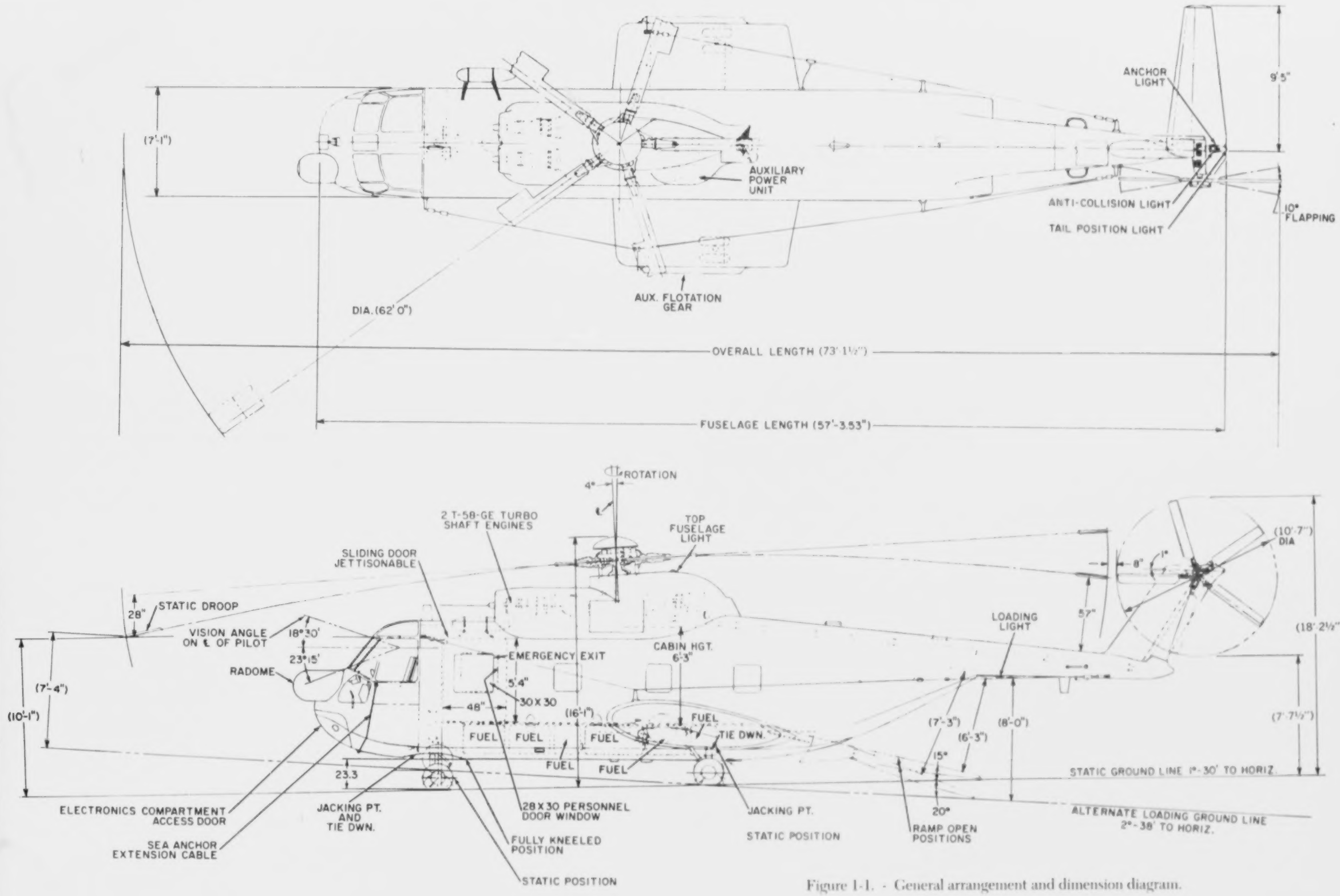


Figure 1-1. - General arrangement and dimension diagram.

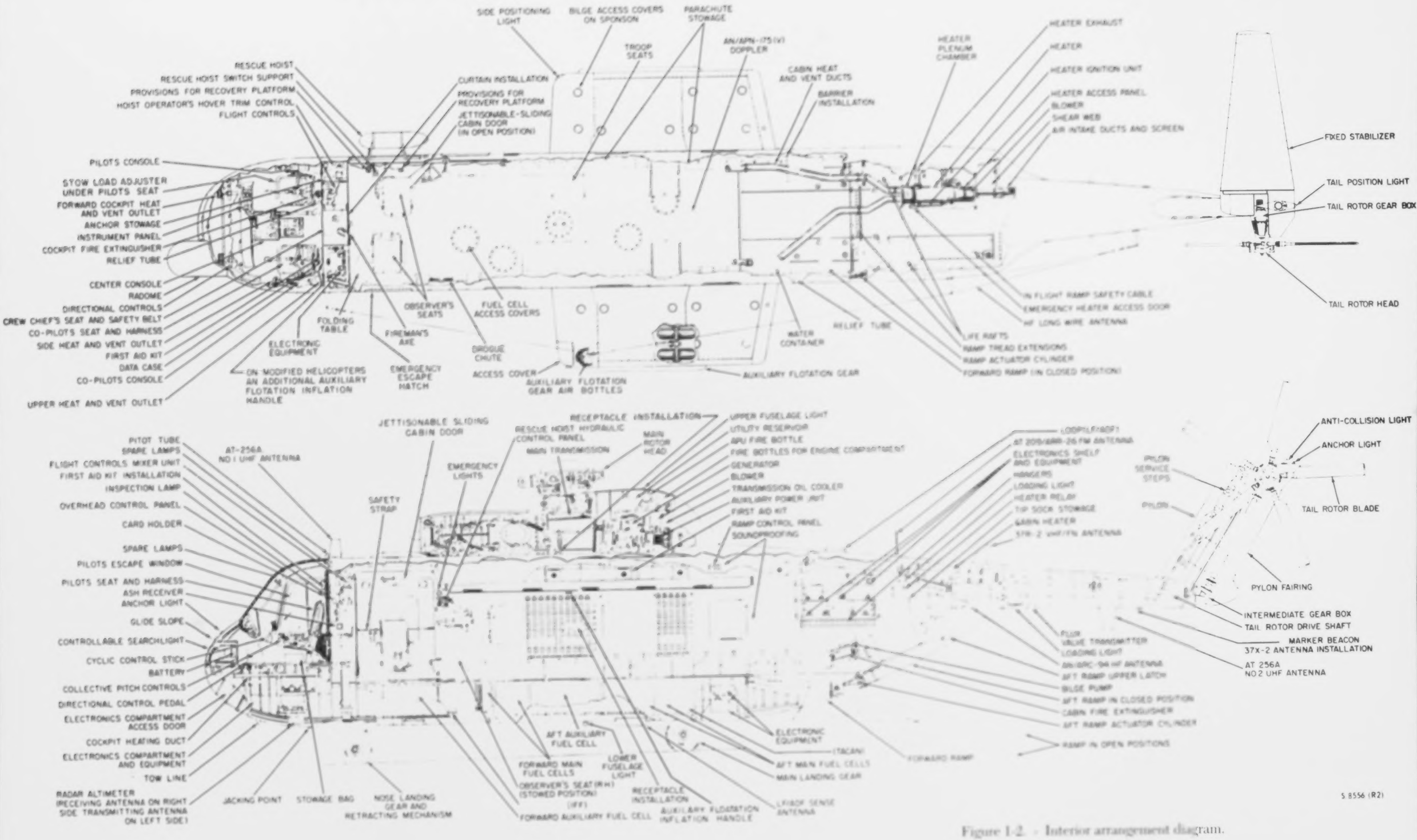


Figure 1-2. - Interior arrangement diagram.

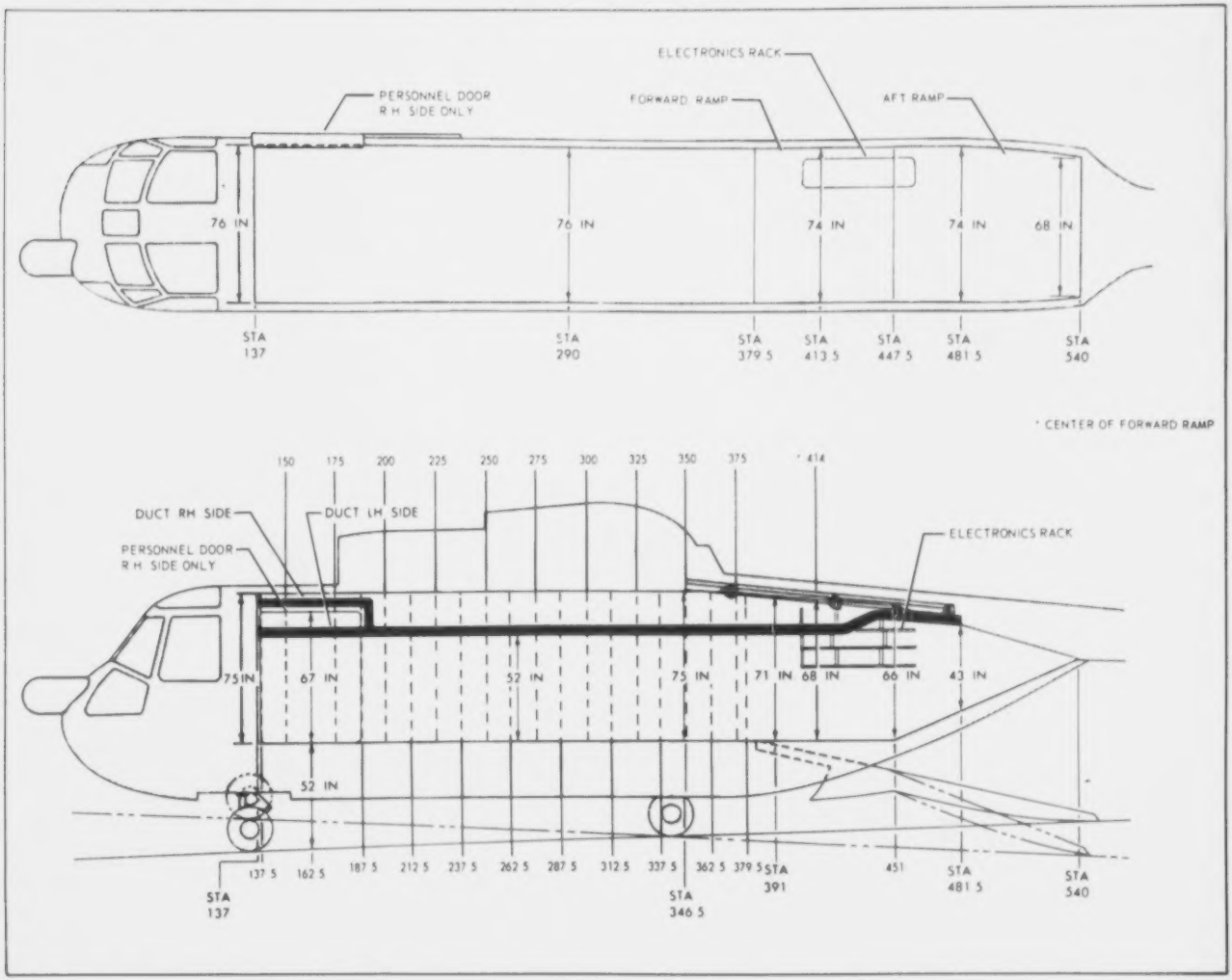


Figure 1-3. - Cabin.

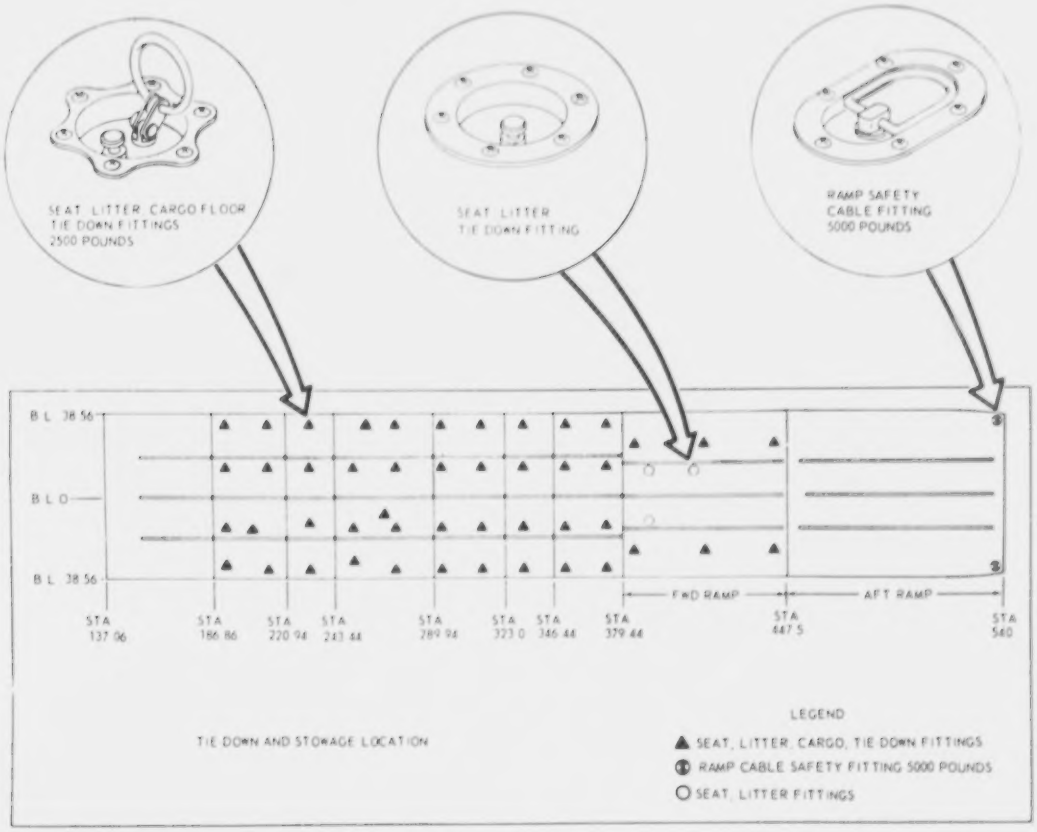


Figure 1-4. - Tiedown fittings, location.

FIRE DETECTION SYSTEMS

Three fire detection systems, one for each engine compartment and one for the APU compartment, provide warning in the event of fire. A single switch is used to test the three systems.

ENGINE AND APU COMPARTMENT FIRE DETECTION SYSTEMS

Four heat-sensitive fire detector elements, located in each engine compartment, are wired into a closed series loop and connected to control units. The elements are mounted on the inside of the engine compartment doors and on both sides of the center firewall. The fire detector elements terminate at the aft firewall. The control units, located overhead in the cargo compartment, continuously monitor the output of the detector elements. In event of fire in an engine compartment, the detector element senses excessive heat and the control unit will close the circuit to fire warning lights in the cockpit. Power for the No. 1 engine fire detection system is supplied by the No. 1 AC primary bus through a circuit breaker, marked (FIRE DET), on the copilot's overhead circuit breaker panel. Power for the No. 2 engine fire detection system is supplied by the No. 2 AC primary bus through a circuit breaker, marked FIRE DET, on the pilot's overhead circuit breaker panel.

The APU fire detection system uses five probe-type detector switches mounted at strategic locations in the APU compartment. When any one of these switches senses excessive heat, it closes a circuit to the APU fire warning lights. Current is supplied from the DC primary bus through a circuit breaker, marked APU, FIRE DET, on the overhead circuit breaker panel.

Fire Warning Lights and Test Switch

When fire is detected in an engine compartment, two red master fire warning lights and red lights installed in the ends of the T-shaped fire emergency

shutoff selector handle for that engine will illuminate. The master fire warning lights marked FIRE are mounted in the instrument panel hood. One light is (10, figure 1-5) located in front of the pilot and the other (36, figure 1-5) in front of the copilot. Fire detected in the APU compartment causes illumination of a light marked FIRE located on the APU control panel, and a light marked APU Fire on the caution advisory panel. A fire warning test switch, marked FIRE WARN TEST, is located on the right side of the instrument panel. The switch is spring-loaded to the center (off) position and has two test positions marked NO. 1 ENG and NO. 2 ENG and APU.

The engine fire detection system is tested by holding the test switch in either test position. The two master fire warning lights and the respective fire emergency shutoff selector handle lights should illuminate. The test switch should return to center when released, and all fire warning lights should go out. The APU fire detection system is tested by holding the test switch in the NO. 2 ENG and APU position. The fire warning lights will illuminate. Current for the engine fire warning test system is supplied by the AC and DC primary buses through appropriately marked circuit breakers. Current for the APU fire warning test system is supplied by the DC primary bus through a circuit breaker marked APU, FIRE DET.

FIRE EXTINGUISHING SYSTEMS

There are two similar Bromotrifluoremethane (CF_3BR) fire extinguishing systems. The engine compartments system has two CF_3BR containers with associated circuitry and plumbing. The APU compartment system has only one container.

WARNING

CF_3BR is highly volatile and is not easily detected by odor. It is not toxic and is considered to be about the same as other freons and carbon dioxide, causing danger primarily by reduction of oxygen. Do not allow liquid to contact the skin because the liquid may cause frostbite or low temperature burns because of its low boiling point.

ENGINE COMPARTMENT FIRE EXTINGUISHING SYSTEMS

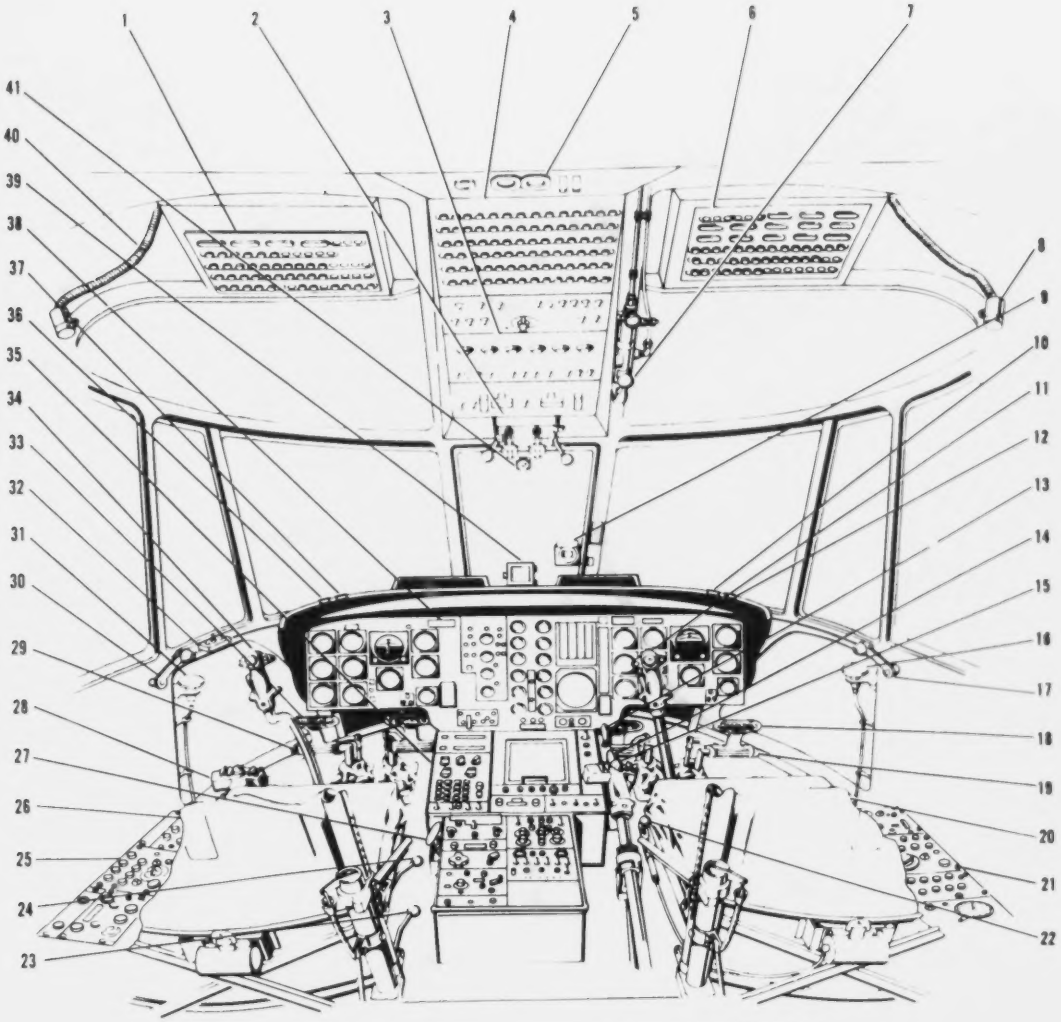
The CF_3BR containers, located aft of the main gear box, are charged with 2.5 pounds of CF_3BR plus a nitrogen charge to propel the agent through tubing to the engine compartments. The tubes for each engine compartment are mounted on the center firewall with discharge nozzles directed at the combustion and power turbine sections of the engine. Each container is equipped with a pressure gage and a thermal discharge valve, which will allow discharge of the containers through a common line when the temperature of the containers reaches 96° to 104°C. (208°F to 220°F.). Each container is equipped with two frangible discs and two explosive cartridges and slugs. The tubing from the disc of each container is tied together to form a single line to each engine. Choice of engine compartment and explosive cartridges is made by pulling out the appropriate engine fire emergency selector handles. The explosive cartridge is fired and the extinguishing agent is discharged by use of the engine fire extinguisher switch. Current for the engine compartment fire extinguishing systems is supplied by the DC primary bus through the circuit breaker marked ENGINE FIRE EXT located on the overhead circuit breaker panel.

Engine Fire Emergency Shutoff Selector Handles

Two T-shaped handles, located on the overhead switch panel, are marked FIRE EMER SHUTOFF SELECTOR, NO. 1, ENGINE and NO. 2 ENGINE. When either handle is pulled down, power from the DC primary bus actuates the fuel shutoff valve, which closes the fuel for that engine, selects that engine compartment to receive the fire extinguishing agent, and energizes the circuit to the fire extinguisher switch. A fire warning light is located in each end of each handle.

Engine Fire Extinguisher Switch

An engine fire extinguisher switch, marked FIRE EXT, located on the overhead switch panel in the pilot's compartment, has marked positions RESERVE, OFF, and MAIN. The lock lever type switch is operative only after one of the fire emergency shutoff selector handles has been pulled. When the engine fire extinguisher switch is held in the MAIN position, after a fire emergency shutoff selector handle has been pulled, the contents of the main fire extinguisher container are discharged into the corresponding engine compartment. When the engine fire extinguisher switch is held in the RESERVE position, after a fire emergency shutoff selector handle has been pulled, the contents of the reserve fire extinguisher container are discharged into the last selected engine compartment.



1 COPILOT'S CIRCUIT BREAKER PANEL
2 ENGINE CONTROL QUADRANT
3 OVERHEAD SWITCH PANEL
4 OVERHEAD DC CIRCUIT BREAKER PANEL
5 PILOT'S COMPARTMENT DOME LIGHT
6 PILOT'S CIRCUIT BREAKER PANEL
7 ROTOR BRAKE LEVER
8 PILOT'S MAP LIGHT
9 STANDBY COMPASS
10 FIRE WARNING LIGHT
11 PILOT'S CYCLIC STICK
12 MASTER CAUTION LIGHT
13 PARKING BRAKE HANDLE
14 NOSE WHEEL LOCK HANDLE
15 PILOT'S COLLECTIVE PITCH LEVER
16 PILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
17 PILOT'S WINDOW EMERGENCY RELEASE HANDLE
18 PILOT'S TOE BRAKES
19 PILOT'S TAIL ROTOR PEDALS
20 PILOT'S SEAT
21 PILOT'S CONSOLE
22 PILOT'S SHOULDER HARNESS LOCK LEVER
23 COPILOT'S SEAT HEIGHT ADJUSTMENT LEVER
24 COPILOT'S SEAT FORWARD AND AFT ADJUSTMENT LEVER
25 COPILOT'S CONSOLE
26 COPILOT'S SEAT
27 ALTERNATE LANDING GEAR HANDLE
28 COPILOT'S COLLECTIVE PITCH LEVER
29 COPILOT'S TAIL ROTOR PEDALS
30 COPILOT'S WINDOW EMERGENCY RELEASE HANDLE
31 COPILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
32 LOG LTS AND REMOTE ICS CONTROL PANEL
33 COPILOT'S TOE BRAKES
34 COPILOT'S CYCLIC STICK
35 COCKPIT CONSOLE
36 FIRE WARNING LIGHT
37 MASTER CAUTION LIGHT
38 INSTRUMENT PANEL
39 SCROLL CHECK LIST
40 COPILOT MAP LIGHT
41 FREE AIR TEMPERATURE GAGE

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Figure 1-5. - Cockpit Arrangement.

Thermal Discharge Indicator

Two red thermal discharge indicators are located aft of the third window on the left side of the fuselage. The indicator marked ENG is connected through a common line to both engine fire extinguisher containers. The indicator marked APU is connected to the APU engine fire extinguisher container. When the temperature reaches 96°C. to 104°C. (208°F. to 220°F.) in any of the containers, the valve in that container will open to relieve pressure. The fire extinguisher agent will then be forced through the lines, eject the seal, and be discharged overboard.

APU FIRE EXTINGUISHER SYSTEM

The fire extinguisher system for the APU unit consists of a charged container of CF_3BR, located adjacent to the APU compartment, with lines, nozzles, and controls similar to the engine compartment extinguisher system. The container holds 2.5 pounds of CF_3BR.

APU Fire Detector and Extinguisher Control Panel

The APU unit fire detector and extinguisher control panel is located on the APU control panel on the pilot's console. The APU fire extinguisher system is energized by first placing the toggle switch marked FUEL SHUTOFF and NORM, in the FUEL SHUTOFF position, then placing the toggle switch, marked FIRE EXTING and OFF, in the FIRE EXTING position. Power for this system is provided by the DC primary bus, through a circuit breaker marked APU, EXT.

SELF-QUIZ # 1

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. Which of the following are features of the HH-3F helicopter?

1. Retractable nose landing gear
2. Five-blade tail rotor
3. A utility hydraulic system used to provide power for an automatic flight control system
4. An auxiliary power unit for driving the gear box accessories
5. Three separate hydraulic systems

A. 1, 2, and 3 only
B. 3, 4, and 5 only
C. 1, 2, 4, and 5
D. 1, 2, 3, and 4

2. What is the MINIMUM tail rotor ground clearance when the blades are rotating?

A. 6 ft. 3½ in.
B. 6 ft. 6½ in.
C. 7 ft. 4½ in.
D. 7 ft. 7½ in.

3. Tiedown fittings installed on the HH-3F cabin floor are rated at _____ pounds.

A. 200
B. 500
C. 2,000
D. 2,500

4. To sense excessive heat, the APU fire detection system uses _____.

A. only four fire detector elements
B. only four probe-type detector switches
C. five fire detector elements
D. five probe-type detector switches

5. The FIRE EXT switch is placed in the MAIN position with neither of the FIRE EMER SHUTOFF SELECTOR handles pulled. What, if anything, should you expect to happen?

A. The MAIN bottle will discharge into the last selected engine
B. The circuit breaker will pop
C. The MAIN bottle will be discharged into the thermal discharge tube
D. Nothing

6. The purpose of the thermal discharge indicator in a fire extinguisher system is to indicate _____.

A. that the container has discharged due to an abnormally high container pressure
B. that the container chemical has become overage
C. that the container pressure has dropped too low to be effective
D. the temperature of the chemicals within the container

ANSWERS TO SELF-QUIZ #1

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	1-1
2	D	1-2
3	D	1-2
4	D	1-8
5	D	1-9
6	A	1-11

HH-3F HELICOPTER ENGINE AND ROTOR SYSTEMS

6

Reading Assignment:
Pages 2-1 through 2-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Explain the basic operation of the T58-GE-5 engine.
2. Describe the following engines systems:
   a. Fuel
   b. Oil
3. Explain the operation of the following rotor systems:
   a. Main
   b. Tail
   c. Rotor brake

ENGINES

The helicopter is equipped with two General Electric T58-GE-5 engines (figures 2-1 and 2-2), each rated at 1,500 shp. The engines are compact turboshaft engines with high power-to-weight ratio and use the free turbine principle. The power turbine is mechanically independent of the gas generator and, within the power turbine governing range, power turbine speed is independent of output power. High torque is available at low output speeds, providing rapid acceleration characteristics. The engines are mounted side-by-side above the cargo compartment forward of the main gear box. Each engine consists of the following major components: an axial-flow compressor, combustion chamber, a two-stage gas generator turbine, and a single-stage free power turbine, which is independent of the gas generator turbine. The gas generator consists of the compressor, annular combustor, and two-stage generator turbine.

The free turbine principle provides a constant free turbine speed output which results in a constant rotor rpm. Power requirements to maintain constant free turbine speed are varied by automatic increases or decreases in gas generator speed. A hydromechanical fuel metering unit provides maximum engine performance without exceeding safe engine operating limits. In the normal operating range, engine speed is selected by positioning the speed selector. The integrated fuel control system delivers atomized fuel in controlled amounts to the combustion chamber. Flow of fuel and air through the combustion chamber is continuous, and once the mixture is ignited, combustion is self-sustained. Changes in air pressure, air temperature, and rotor operation all affect engine performance. With the FOD deflector installed, helicopter velocity has practically no effect on engine performance. The engine fuel control system automatically maintains selected power turbine speed by changing fuel flow to increase or decrease gas generator speed as required, thus regulating output power to match the load under changing conditions. A start bleed valve, mounted on the compressor, automatically opens during the starting cycle to bleed approximately 6.7% of compressor discharge airflow overboard. This decreases compressor discharge pressure, which lessens the possibility of compressor stall and allows the starter to accelerate the gas generator faster. The valve automatically opens when the starter is engaged and remains open until starter dropout. A

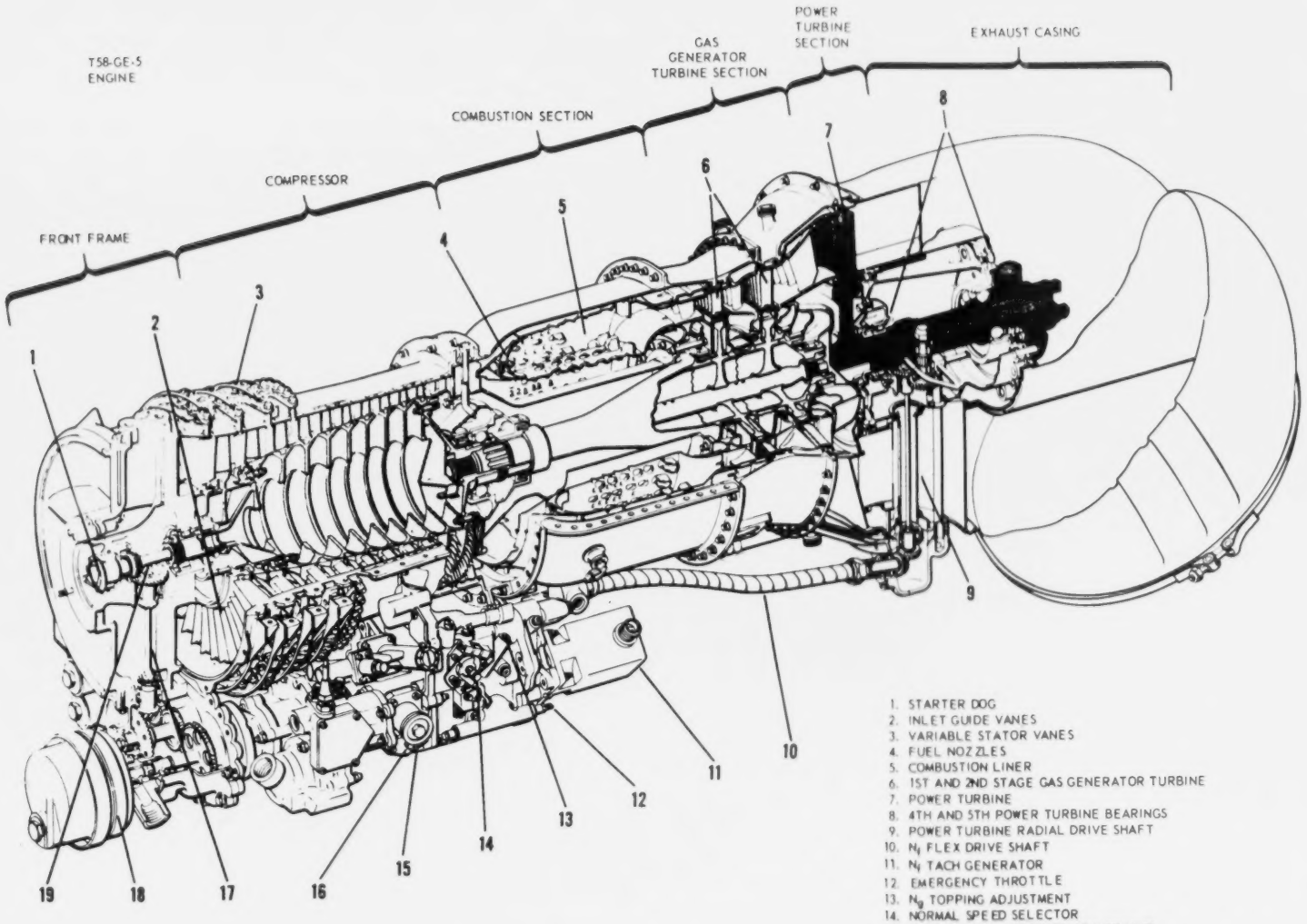

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Figure 2-1 - Engine cutaway view.

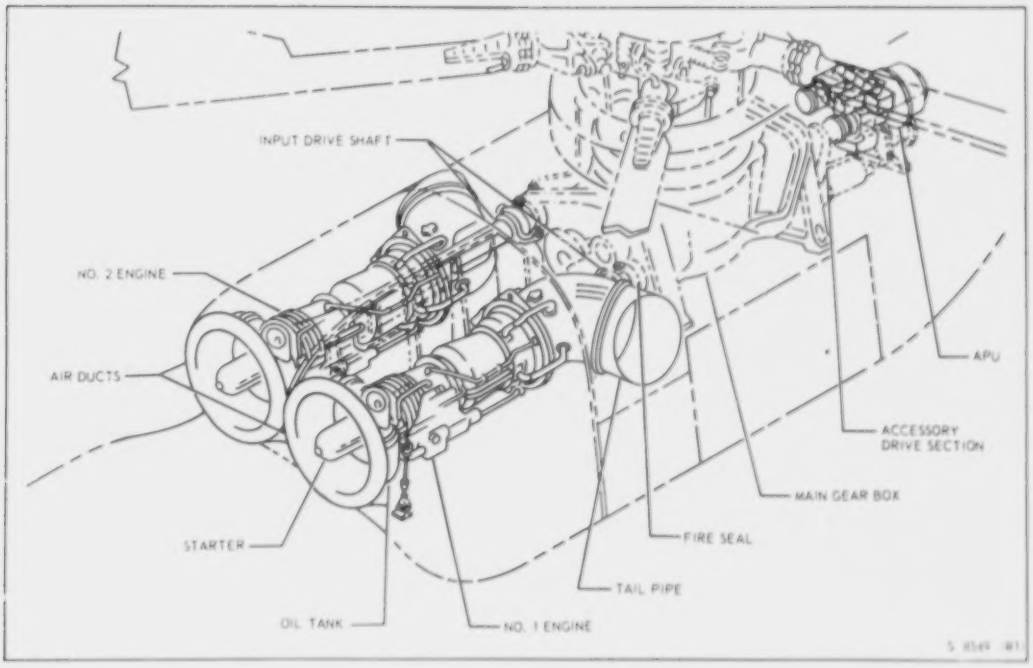


Figure 2-2. - Engine, main gear box, and APU installation.

start fuel valve is installed between the engine fuel control and flow divider. This valve, when closed, shuts off auxiliary starting fuel flow. The pilot may use the valve during the starting cycle to reduce starting fuel flow, which decreases the possibility of a hot start.

COMPRESSOR

The ten-stage compressor consists of the compressor rotor and stator. The compressor rotor is supported by the front frame section and the compressor rear frame section. The stator is bolted between the front frame section and compressor rear frame section. The stator is bolted between the front frame section and compressor rear frame. The primary purpose of the compressor is to compress air for combustion. Ambient air enters through the front frame and is directed to the compressor inlet, passes through ten stages of compression, and is directed to the combustion chambers. The inlet guides vanes (2, figure 2-1) and the first three stages of the stator vanes (3, figure 2-1) are variable, and change their angular position as a function of compressor inlet temperature and gas generator speed to prevent stall of the compressor.

COMBUSTION CHAMBER

In the combustion chamber, fuel is added to the compressed air. This mixture is ignited, causing a rapid expansion of gases toward the gas generator turbine section. As the air enters the combustion section, a portion goes into the combustion chamber where it is mixed with the fuel and ignited, while the remaining air forms a blanket between the outer combustion casing and the combustion liner (5, figure 2-1) for cooling purposes. Once combustion is started by the two igniter plugs, it is self-sustaining. After the air has been expanded and increased in velocity by combustion, it is passed through the first-stage turbine wheel of the gas generator turbine (6, figure 2-1).

GAS GENERATOR TURBINE

The two-stage gas generator turbine (6, figure 2-1) is the rotating component which is coupled directly to the compressor. The turbine extracts the required power from the exhaust gases to drive the compressor. The turbine nozzles that comprise the stator blades direct the exhaust gases to the turbine wheels.

POWER TURBINE

The power turbine (7, figure 2-1) is bolted to the rear flange of the second-stage turbine casing. The engine uses the free turbine principle wherein engine output power is provided by the power turbine rotor, which is mechanically independent of the gas generator rotor. This rotor derives its power from the gases which are directed to it by the gas generator turbine nozzles. Within the normal operating range, power turbine speed may be maintained or regulated independent of output power. This principle also provides more rapid acceleration because of the availability of high engine torque at low output speeds.

GAS GENERATOR SPEED (N_g)

Gas generator speed (N_g) is primarily dependent upon fuel flow and is monitored by the engine fuel control unit. The principal purpose of monitoring N_g is to control acceleration and deceleration characteristics, prevent overspeed, and establish a minimum idle setting. Gas generator speed controls mass airflow pumped through the engine and consequently the power available to the power turbine.

FREE POWER TURBINE SPEED (N_f)

The free power turbine speed (N_f) is dependent upon speed selector position and rotor load. The fuel control monitors N_f to regulate fuel flow to maintain an essentially constant power turbine speed for a given speed selector position.

ENGINE FUEL SYSTEM

The engine fuel systems (figure 2-3), one for each engine, consists of an engine-driven pump, a dynamic filter, a fuel control unit, a static filter, an oil cooler, a flow divider, a fuel manifold, and associated piping. The fuel control unit is supplied fuel from the engine-driven fuel pump. Metered fuel from the engine fuel control unit is piped through an oil-fuel heat exchanger and then enters the flow divider connected directly to the fuel manifold on the engine. For normal flight, rotor speed is selected by positioning the speed selectors, and the engine fuel controls will meter fuel to maintain the selected rotor speed.

Engine-Driven Fuel Pump

A dual operation engine-driven fuel pump is mounted on each engine. The pump consists of a

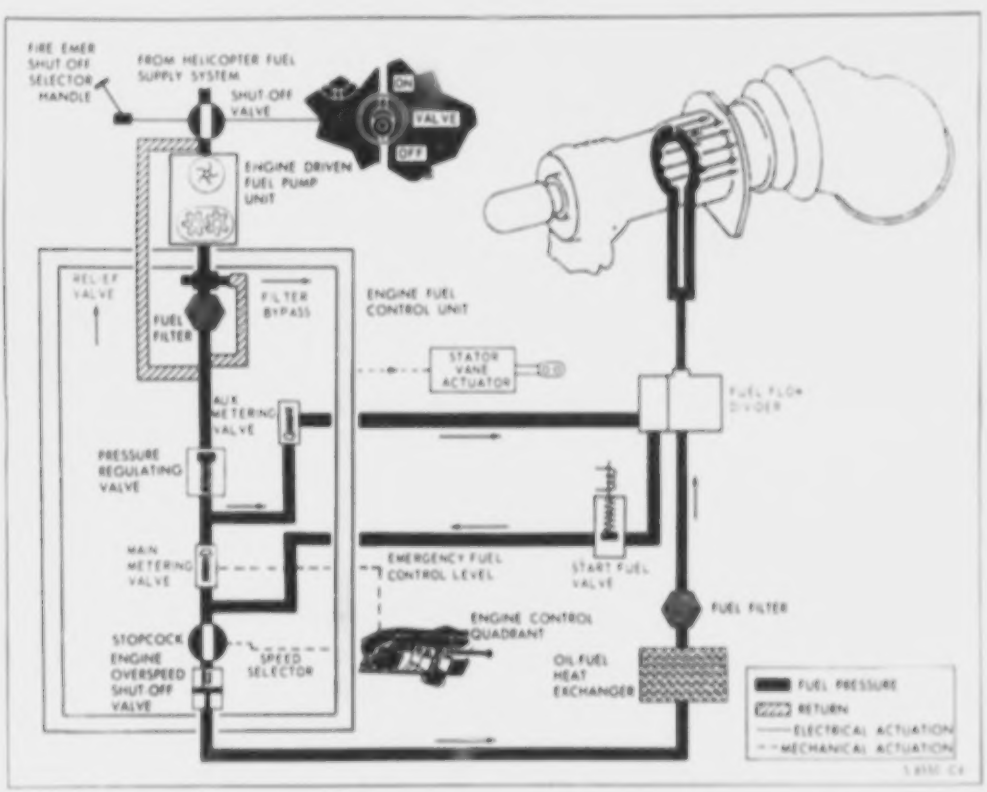


Figure 2-3. - Engine fuel system.

positive displacement type gear pump and a centrifugal boost pump and is built into a single housing. The engine accessory drive section furnishes power for each pump by means of a splined shaft. This shaft drives the fuel pump and simultaneously acts as a link to transmit gas generator speed information to the engine fuel control unit. If the engine-driven fuel pump or splined shaft fails, the engine will flame out due to fuel starvation.

Engine Fuel Control Unit

The engine fuel control units, one located on each engine, are hydromechanical units that regulate engine fuel flow to maintain a selected constant free power turbine speed and a constant rotor speed (N_r). Fuel from the engine fuel pump enters the fuel control unit through the inlet and passes through the fuel filter. The fuel control has a fuel metering section and a computing section. The metering section selects the rate of flow to the combustion chambers, based on information received from the computing sections. The metering section has a metering valve and a pressure regulating valve. The pressure regulating valve maintains a constant pressure across the main metering valve by bypassing excess fuel back to the engine fuel pump inlet. The metering valve is positioned in response to various internal operating signals, and meters fuel to the engine as a function of these intergrated signals. The engine fuel control unit prevents compressor stall, turbine overtemperature, rich or lean blowouts, governs gas generator idle and maximum speeds, and schedules inlet guide and stator vane positions to provide optimum compressor performance.

SPEED SELECTORS (ENGINE SPEED SELECTOR LEVERS)

Two speed selectors, marked NUMBER 1 ENGINE and NUMBER 2 ENGINE, are located on the overhead engine control quadrant. Marked positions on the overhead quadrant are SHUT-OFF, GRD IDLE, MIN GOV, and 100% SPEED. The speed selectors are connected directly to the fuel stopcock and indirectly to the fuel metering valve in the fuel control unit. When the speed selectors are in the SHUTOFF position, fuel flow to the fuel nozzles is stopped by means of a stopcock that prevents fuel from entering the combustion chambers. The stopcock is open whenever the speed selector is 6 degrees or more from the SHUTOFF position and is closed when the speed selector is 3 degrees or less from the SHUTOFF position. The GRD IDLE position schedules fuel flow to produce approximately 56 percent N_g. Gas generator idle speed will vary with inlet air temperature. A limit stop at GRD IDLE prevents inadvertent retarding of the speed selectors below the idle speed of the engines. The speed selectors may be retarded from the limit stop by exerting a downward and rearward pressure on the speed selectors. The MIN GOV position of the speed selector is the point where the governing range of the power turbine is entered and is approximately 87% N_r. When the speed selector is at the full forward position, the engine is producing maximum power turbine speed. Engine speed trim switches are installed on the collective stick grip to provide accurate speed changes and engine synchronization. With the speed selectors in the governing range, any force tending to slow the rotor system, such as increases in collective pitch, will be sensed by the fuel control unit, which will attempt to maintain constant N_r/N_f by increasing power.

ENGINE SPEED TRIM SWITCHES

The engine speed trim switches, located on each collective lever grip, are used to make adjustments to power turbine speed and for engine synchronization. The switches, marked ENG TRIM, 1 and 2, + (plus) -(minus), provide electrical power to actuators in the overhead control quadrant, which are connected to the speed selectors. The pilot's engine speed trim switches will override the copilot's. Moving the ENG TRIM switches forward will cause increases in power turbine speed, and moving the switches aft will cause decreases in power turbine speed. When the desired power turbine speed is attained, the switches are released and will return to the spring-loaded center position. The switches are capable of advancing the speed selectors from shutoff to the ground idle detent and, if manually removed from the detent, to the full forward position. The switches are capable of retarding the speed selectors from full forward to 93 + 1%N_r. The ENG TRIM switches receive electrical power from the DC primary bus through circuit breakers under the general heading ENGINE (SPEED TRIM, 1-ENG-2), located on the center overhead DC circuit breaker panel.

EMERGENCY FUEL CONTROL LEVERS

Two emergency fuel control levers, one for each engine, marked EMER FUEL CONTROL, are located on each side of the engine control quadrant. The emergency fuel control levers operate independently and are used if the fuel control unit malfunctions. Each emergency fuel control lever has positive stops, marked OPEN and CLOSE, and is connected directly by a flexible cable and linkage to the main metering valve in each engine fuel control unit. The primary function of the emergency fuel control lever is to manually override the automatic features of the fuel control, and must be used with extreme caution.

ENGINE OIL SYSTEM

Each engine has an independent oil tank and dry sump full scavenge oil system (figure 2-4). Oil is gravity fed from the tank to the engine-driven oil pump mounted on the forward right-hand side of the engine. The engine-driven pump distributes oil, under pressure, through a filter to accessory gears and engine bearings. The oil serves both lubricating and cooling purposes, and the system is completely automatic. The scavenge side of the pump returns the oil through an oil cooler to the oil tank. The oil cooler is an oil-to-fuel heat exchanger with an associated oil bypass system. The oil flow through the cooler depends on oil temperature. At low oil temperature, most of the oil bypasses the cooler. Higher oil temperatures close the bypass valve and cause all of the oil to flow through the cooler. Each engine oil system has a useful capacity of 2.5 U.S. gallons of oil in a 3.0 U.S. gallon tank (0.5 gallon expansion space). The circular tanks are located around the forward section of each engine.

ROTOR SYSTEMS

The rotor systems consist of a single main rotor and an anti-torque tail rotor. Both systems are driven by the two engines through the transmission system and are controlled by the flight controls. (See figure 2-5.)

MAIN ROTOR SYSTEM

The main rotor system consists of the main rotor head assembly and the rotor blades. The head assembly, mounted directly above the main gear box, consists of a hub assembly and a swashplate assembly. The hub assembly, consisting of five sleeve-spindle assemblies and five hydraulic dampers clamped between two parallel plates, is splined to the main rotor drive shaft. The root ends of the five rotor blades are attached to the sleeve-spindle assemblies, which permit each blade to flap vertically, hunt horizontally, and rotate about their span-

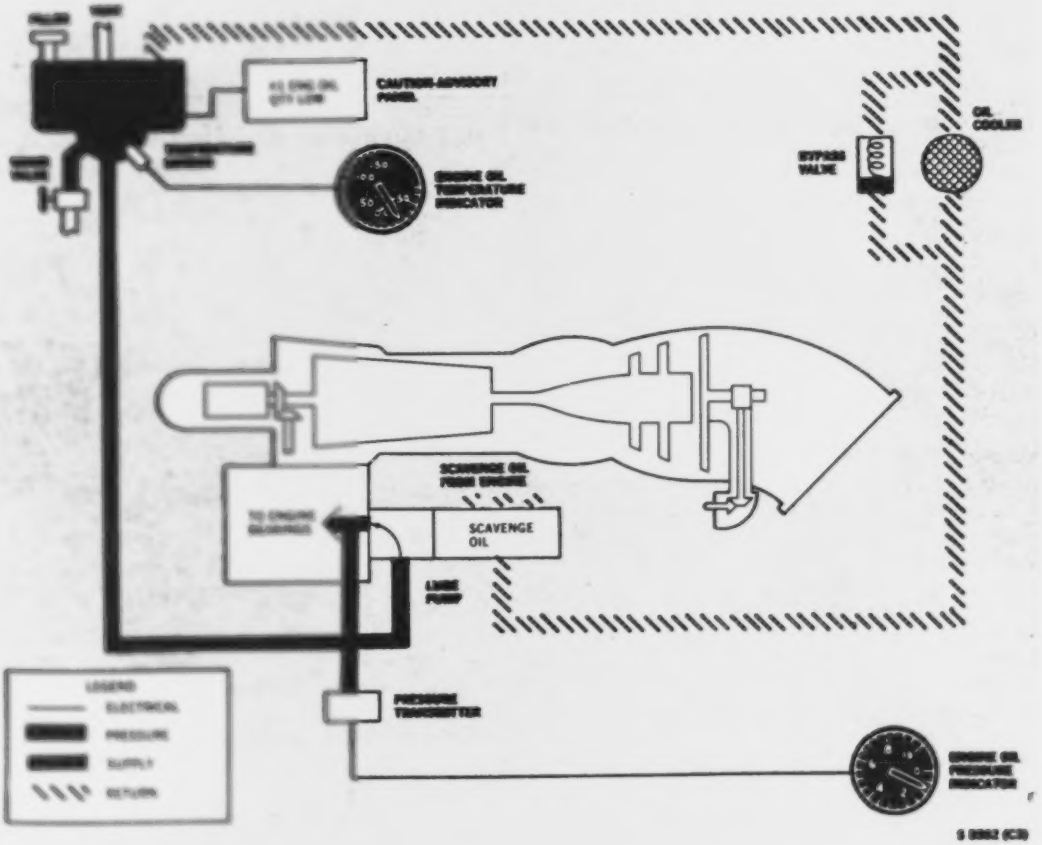


Figure 2-4. - Engine oil system.

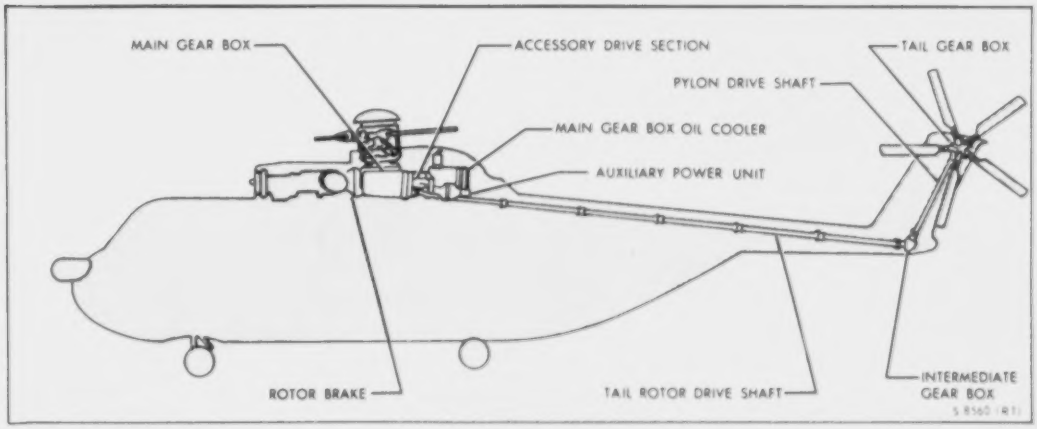


Figure 2-5. - Rotor systems.

wise axis. Anti-flapping restrainers limit the upward movement of the blades, and droop stops limit the downward movement of the blades. Both are in operation when the blades are stopped or turning at low speed. When speed is increased to approximately 25 percent (50 rpm) rotor speed, centrifugal force automatically releases the anti-flapping restrainers. The droop stops release at approximately 75 percent (152 rpm) rotor speed. The hydraulic dampers minimize hunting movement of the blades about the vertical hinges as they rotate, prevent shock to the blades when the rotor is started or stopped, and aid in the prevention of ground resonance.

The five all-metal main rotor blades are of the pressurized spar type, identified as BIM blades. The blades are constructed of aluminum alloy, with the exception of forged steel cuffs which attach the root ends of the blades to the sleeve-spindle assemblies on the main rotor hub. Each blade consists of a hollow extruded aluminum spar pressurized with nitrogen, 25 aluminum blade pockets, a tip cap, an aluminum root cap, a steel cuff, a pressure (BIM) indicator, an air valve, and an abrasion strip. Vent holes on the underside of each pocket prevent accumulation of moisture inside the blade. Each blade is balanced statically and dynamically within tolerances that permit individual replacement of the blades. In addition, a pretrack number is stenciled on each blade to eliminate the necessity for blade tracking. Balancing and the assignment of a pretrack number is done during manufacture or overhaul.

The swashplate assembly consists of an upper (rotating) swashplate, which is driven by the rotor hub, and a lower (stationary) swashplate, which is secured by a scissors assembly to the main gear box to prevent rotation. Both swashplates are mounted on a ball-ring and socket assembly, which keeps them parallel at all times, but allows them to be tilted, raised, or lowered simultaneously by components of the main rotor flight control system, which connect to arms on the lower (stationary) swashplate. Cyclic or collective pitch changes, introduced at the stationary swashplate, are transmitted to the blades by linkage on the rotating swashplate.

Bifilar Absorber

The main rotor system is equipped with a bifilar absorber assembly to reduce fatigue stress and improve the overall vibration comfort level throughout the helicopter. The bifilar absorber assembly, secured to the main rotor hub, consists of a five-pointed, star-shaped, aluminum forging with a 17-pound weight attached to each star point. Each weight is enclosed by a fairing to reduce drag.

The HH-3F helicopter is equipped with an In-Flight Blade Inspection System (IBIS) that visibly indicates in the cockpit that the pressure in one or more main rotor blade spars has dropped below the allowable limit.

The IBIS indicator, located on the back wall of the spar of each main blade, contains a small radioactive source (100 microcuries strontium 90) which is completely shielded and emits no radiation when the rotor blade spar is at normal pressure. When the pressure in the rotor blade spar drops below 6.1 ($\pm$ 0.4) psi, the indicator will activate,

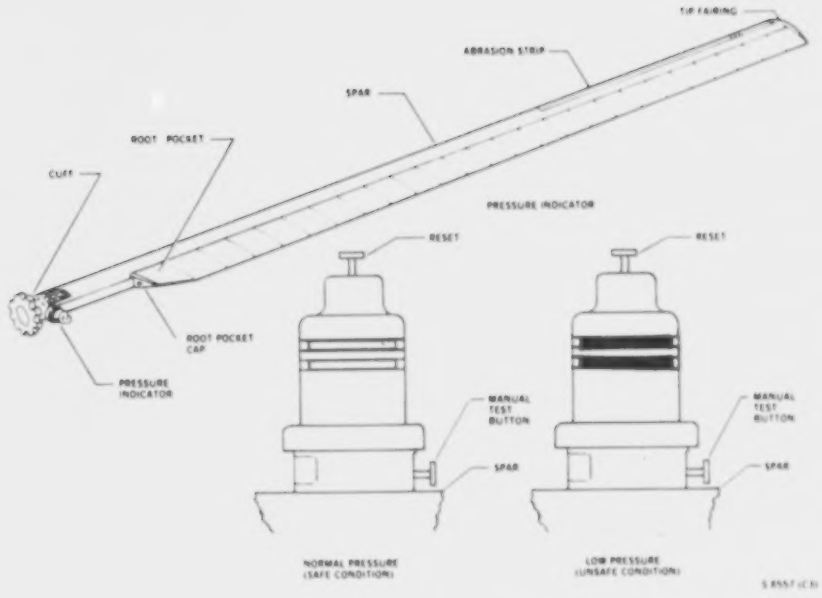


Figure 2-6. - IBIS indicator.

causing the radioactive source to move to an unshielded position, thereby emitting beta radiation. The detector assembly, located aft of the main rotor shaft under the transmission cowling, detects the beta radiation and sends a signal to the blade processor. This signal processor causes the BLADE PRESS light on the caution advisory panel to illuminate, indicating a loss of pressure in one or more of the blade spars. Loss of pressure in the blade spar is also indicated by the IBIS indicator located in the back wall of the spar of each main blade. The indicator, compensated for temperature changes, compares a reference pressure built into the indicator with the pressure in the blade spar. When the pressure in the blade spar is within the required service limits, two yellow strips show in the indicator. If the pressure in the blade spar drops below the minimum permissible service pressure, the indicator will be activated and will show two red stripes. Loss of 115 volt AC power, failure of the detector, and/or failure of the signal processor will cause the BLADE PRESS caution light to illuminate. The system receives electrical power from the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's overhead circuit breaker panel marked IBIS, under the general heading NO 1 AC PRI. The BLADE PRESS caution light is powered by the DC primary bus, and is protected by a circuit breaker on the copilot's overhead circuit breaker panel marked IBIS, under the general heading DC PRI.

WARNING

When red is visible in the indicator, determine the cause of the red indication before accepting the helicopter for flight.

TAIL ROTOR

The tail rotor consists of the tail rotor assembly and tail rotor blades. The tail rotor assembly, mounted at the upper end of the pylon, consists of a tail rotor hub and pitch-changing mechanism. The splined hub is supported and driven by the horizontal output shaft of the tail gear box. The five tail rotor blades are attached to the tail rotor hub in such a way that they are free to flap and rotate about their spanwise axis for pitch variation. The blade pitch-changing mechanism transmits tail rotor control pedal movements to the tail rotor blades through the pitch change beam of the tail gear box (See figure 2-5).

ROTOR BRAKE

A hyrdraulically actuated rotor brake (figure 2-7), mounted on a brake shaft forward of the main gear box, stops the rotation of the rotor system and prevents its rotation, when the helicopter is parked. The rotor brake system consists of a hydraulic actuating cylinder and lever, pressure gage, hydraulic brake cylinders, rotor brake reservoir, and brake

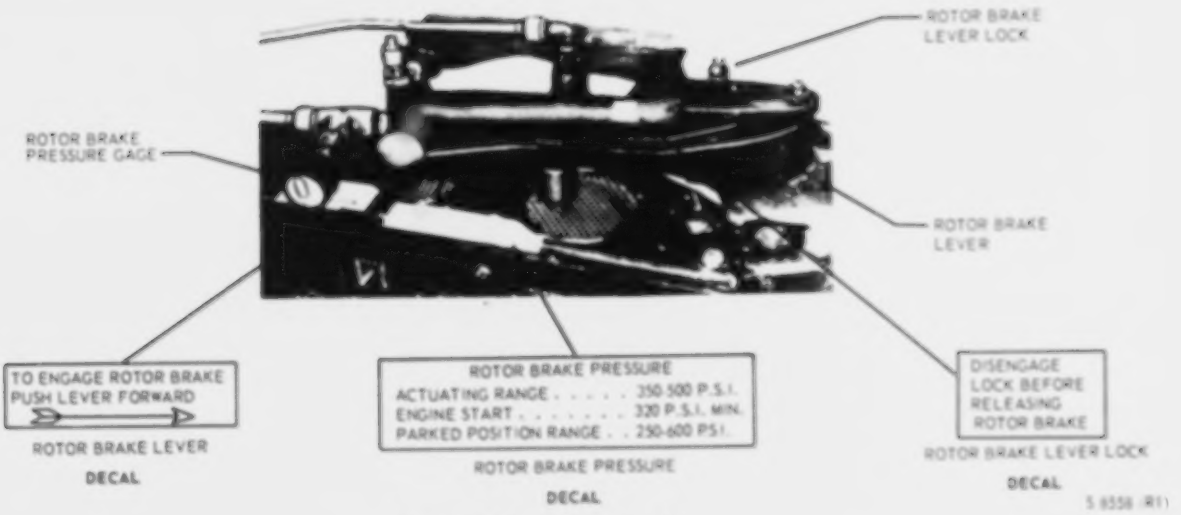

ROTOR BRAKE LEVER LOCK
ROTOR BRAKE PRESSURE GAGE
ROTOR BRAKE LEVER
TO ENGAGE ROTOR BRAKE PUSH LEVER FORWARD
ROTOR BRAKE LEVER
DECAL
ROTOR BRAKE PRESSURE
ACTUATING RANGE . . . . . 350-500 P.S.I.
ENGINE START . . . . . 320 P.S.I. MIN.
PARKED POSITION RANGE . . 250-600 PSI.
ROTOR BRAKE PRESSURE
DECAL
DISENGAGE LOCK BEFORE RELEASING ROTOR BRAKE
ROTOR BRAKE LEVER LOCK
DECAL
S-8358-(R1)

Figure 2-7. - Rotor brake.

disc. The rotor brake hydraulic actuating cylinder and lever, located on the pilot's compartment ceiling, operates independently from the hydraulic systems. A spring-loaded accumulator, connected to the rotor brake hydraulic lines at the forward end of the transmission compartment, assures continuous hydraulic pressure when the rotor brake lever is applied. The rotor brake hydraulic actuating cylinder in the cockpit is gravity fed with hydraulic reservoir, located on the right aft side of the main gear box. When filled to the FULL mark, the reservoir contains approximately 3.2 ounces of fluid. The hydraulic brake cylinders are located on supports attached to the main gear box. The brake disc is positioned on the main input shaft of the main gear box. The rotor brake system components are discussed in detail in the following paragraphs.

Rotor Brake Cylinder and Lever

A rotor brake lever (figure 2-7) is connected directly to the rotor brake hydraulic actuating cylinder on the pilot's compartment ceiling to the right and forward of the overhead switch panel. The rotor brake is applied by pulling down and pushing forward as indicated on the decal aft of the lever on the upper structure. The decal is marked TO ENGAGE ROTOR BRAKE PUSH LEVER FORWARD. The decal also has an arrow pointing forward. A spring-loaded lock, located at the forward outboard side of the cylinder, automatically locks the brake lever in the applied (forward) position if the pilot places the small handle on the horizontal, forward position. The lockpin must be pulled out to allow rotor brake release. The lockpin may be rendered inoperative by rotating it until it remains in the OUT position.

Rotor Brake Pressure Gage

A hydraulic actuated rotor brake pressure gage is located to the rear of the rotor brake lever (figure 2-7) on the pilot's compartment ceiling. The reading is indicated by the pointer and indicates psi. A decal, marked ROTOR BRAKE PRESSURE, ACTUATING RANGE 350-500 PSI., ENGINE START 320 PSI MIN., PARKED POS. RANGE 250-600 PSI., is located adjacent to the rotor brake pressure gage. To ensure that the rotors will not turn with both engines in GRD IDLE, a minimum of 320 psi is required before the engines are started. For parking, 250-600 psi is the normal pressure range.

Rotor Brake Caution Light

The rotor brake caution light, marked ROTOR BRAKE, is located on the caution advisory panel on the pilot's side of the instrument panel. The light is provided as an aid in the prevention of rotor engagement while the rotor brake is engaged. Whenever the rotor brake hydraulic pressure is 10 $\pm$ 1 psi or above and electrical power is supplied to the DC primary bus, the caution light will go on. When the rotor brake pressure drops below 10 $\pm$ 1 psi, the light will go out. Normally with rotor brake off, pressure should be zero; however, after the rotor brake is released and pressure at 10 $\pm$ 1 psi or above is trapped in the system, the caution light will remain on. If the pressure reaches 20 psi, the pucks will begin to drag.

SELF QUIZ #2

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The HH-3F is equipped with two _____.

   A. T58-GE-8 engines rated at 1300 shp
   B. T58-GE-5 engines rated at 1500 shp
   C. T58-GE-8 engines rated at 1100 shp
   D. T58-GE-5 engines rated at 1400 shp

2. The HH-3F engine centrifugal fuel filter is located _____.

   A. under the engine front frame
   B. under the engine compressor section
   C. above the engine fuel control
   D. on the engine fuel control

3. What is the function of the fuel control?

   A. Maintain a constant selected power turbine speed
   B. Permit helicopter rotor speed to vary up to 50 percent
   C. Vary the power turbine speed to maintain a constant helicopter rotor rpm
   D. Maintain a constant helicopter rotor load to maintain a constant power turbine speed

4. The engine speed trim switches are located on _____.

   A. the overhead engine control quadrant
   B. each cyclic pitch stick grip
   C. each collective stick grip
   D. pilot's overhead emergency console

5. Which statement is NOT true concerning the bifilar vibration absorber?

   A. It is a five-armed aluminum forging
   B. It uses a 17-pound steel weight
   C. The bifilar arms have an H-beam cross section
   D. Each weight is enclosed in a special fairing

6. What color on a blade pressure indicator indicates a NORMAL condition?

   A. Gray
   B. Green
   C. Yellow
   D. White

7. The tail blade pitch is changed by movement of the _____.

   A. output gear shaft
   B. pitch change beam
   C. counterweight assembly
   D. flapping spindles

8. For effective rotor brake operation, you must develop a MINIMUM of _____ psi with the rotor brake handle.

   A. 10
   B. 100
   C. 320
   D. 600

ANSWERS TO SELF-QUIZ #2

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	2-1
2	A	2-2
3	A	2-5
4	C	2-5
5	C	2-7
6	C	2-8
7	B	2-8
8	C	2-9

HH-3F HELICOPTER TRANSMISSION AND VARIOUS SYSTEMS

Reading Assignment:
Pages 3-1 through 3-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Transmission system: Main gear box, intermediate gear box, tail gear box.
2. Transmission oil systems: Main, augmented main, intermediate and tail gear box.
3. Fuel supply system.
4. Electrical supply system.
5. Utility hydraulic supply system.

TRANSMISSION SYSTEM

The transmission system (figure 3-1) consists of three gear boxes that transmit power to the main and tail rotors. The main gear box reduces engine rpm and interconnects the two engines to the rotor head. A freewheeling unit, located at each engine input to the main gear box, permits the rotor head to autorotate without power turbine drag if the engine (or engines) fails, or when power turbine rpm decreases below rotor rpm. Engine torque is transmitted through the main gear box to the main rotor drive shaft to drive the main rotor, and aft through a tail rotor drive shaft to the intermediate gear box at the base of the pylon. From the intermediate gear box, a pylon drive shaft extends upward to the tail gear box to drive the tail rotor. Each of the three gear boxes has a chip detector.

MAIN GEAR BOX

The main gear box, mounted above the cargo compartment aft of the engines, is a four-stage reduction gear system which reduces engine rpm at a ratio of approximately 93.4 to 1 for driving the rotor head. The main gear box contains a spur, helical bevel gear, and a single planetary gear stage. Shafting extends from the main gear box lower housing to the intermediate gear box and then to the tail gear box to drive the tail rotor. The main gear box accessory section, located at the rear of the main gear box lower housing, drives the primary, utility, and auxiliary hydraulic pumps, the main gear box oil pumps, the high pressure torquemeter oil pump, and the two generators. The auxiliary power unit drives the accessory section of the main gear box on the ground before the engines are started. When the APU is operated at 100% speed, the APU drive shaft will drive the accessory section until the rotor reaches 100% N_r. The APU has a clutch, which contains a freewheel unit, that enables shutdown of the APU when the rotor head is engaged. There is a through shaft, driven by the No. 1 engine, in the main gear box. Under normal conditions with the rotor turning, the gear box accessories are driven by the tail takeoff drive unit, which is provided with a freewheel unit. If this freewheel units fails, the through shaft will drive the accessories.

INTERMEDIATE GEAR BOX

The intermediate gear box, located at the base of the tail rotor pylon, contains a bevel gear direct-drive system to change the direction of the shafting that transmits engine torque to the tail gear box. The intermediate gear box is splash-lubricated. Screened air outlets in the pylon fairing permit the gear box to be cooled by the rotor downwash.

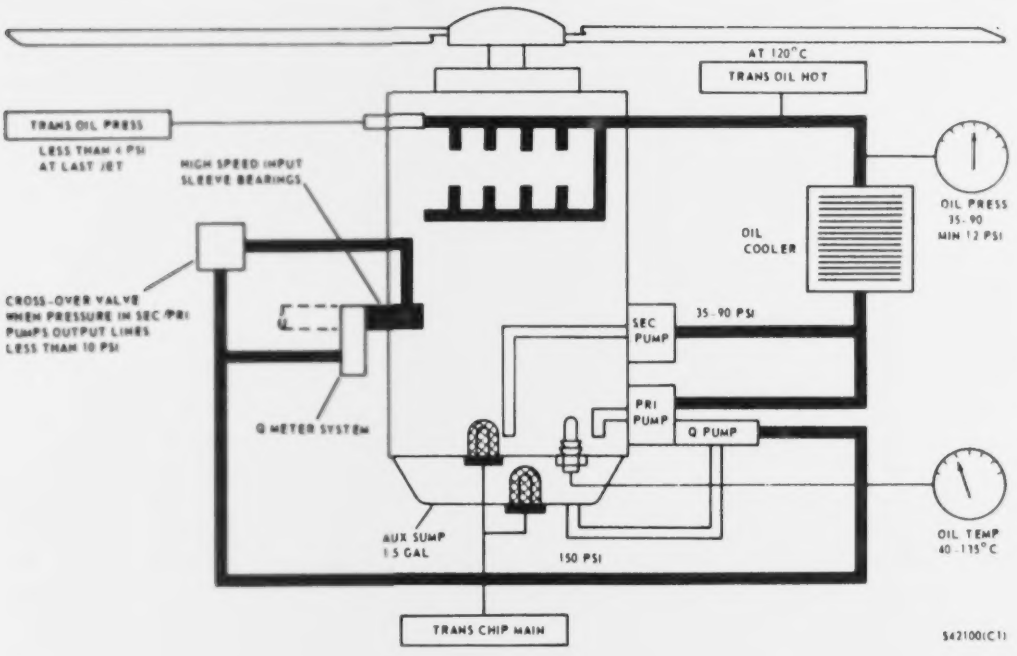


Figure 3-1. - Main transmission with auxiliary sump.

TAIL GEAR BOX

The tail gear box, located at the upper end of the tail rotor pylon, contains a bevel gear reduction-drive system to transmit engine torque to the tail rotor. The tail gear box also contains part of the pitch change linkage which extends through the hollow output shaft to the tail rotor hub. The tail gear box is splash-lubricated.

TRANSMISSION OIL SYSTEMS

Main Gear Box Oil System

(See figure 3-1)

Primary and secondary oil pumps are provided for lubrication. The torque system oil pump is mounted piggy back to the primary pump on the lower portion of the rear cover of the main gear box, and uses main transmission oil for the torque sensing system. The secondary oil pump is mounted between the utility hydraulic pump and the rear cover mounting pad. Oil is pumped from the gear box sump to the oil cooler located behind the main gear box. Cooling air is forced through the cooler by a blower driven by belts from the tail drive shaft. The air is then exhausted through a screened transmission accessories cooling air outlet at the rear of cooler, the oil returns to the main gear box where it is sprayed onto the gears and bearings through jets built into the gear box castings. An oil filler, accessible from the left side of the main gear box fairing, is located on the left side of the gear box. A window in the gear box below the oil filler provides a sight check for the oil level in the main gear box. Oil capacity is 15 gallons; normal servicing is 11 gallons.

AUGMENTED MAIN GEAR BOX OIL SYSTEM

The augmented main gear box oil system will permit the helicopter to continue operating for approximately 45 minutes if there is a failure in the main lubrication system. In this case, the auxiliary sump, at the base of the main gear box, provides an oil supply of about 1.5 gallons to lubricate the input sleeve bearings in the high speed section of the main gear box. The torquemeter pump uses oil from the auxiliary sump to lubricate these bearings and to supply oil to the torque sensing system. An additional chip detector is installed in the auxiliary sump and lights the XMSN CHIP MAIN caution light.

INTERMEDIATE AND TAIL GEAR BOX OIL SYSTEMS

Both the intermediate and tail gear boxes are splash-lubricated from individual sump systems. Internal spiral channels ensure oil lubrication to all bearings. An oil filler plug, drain plug, and oil level sight gage are located in each gear box casting. When the oil in the intermediate gear box is at

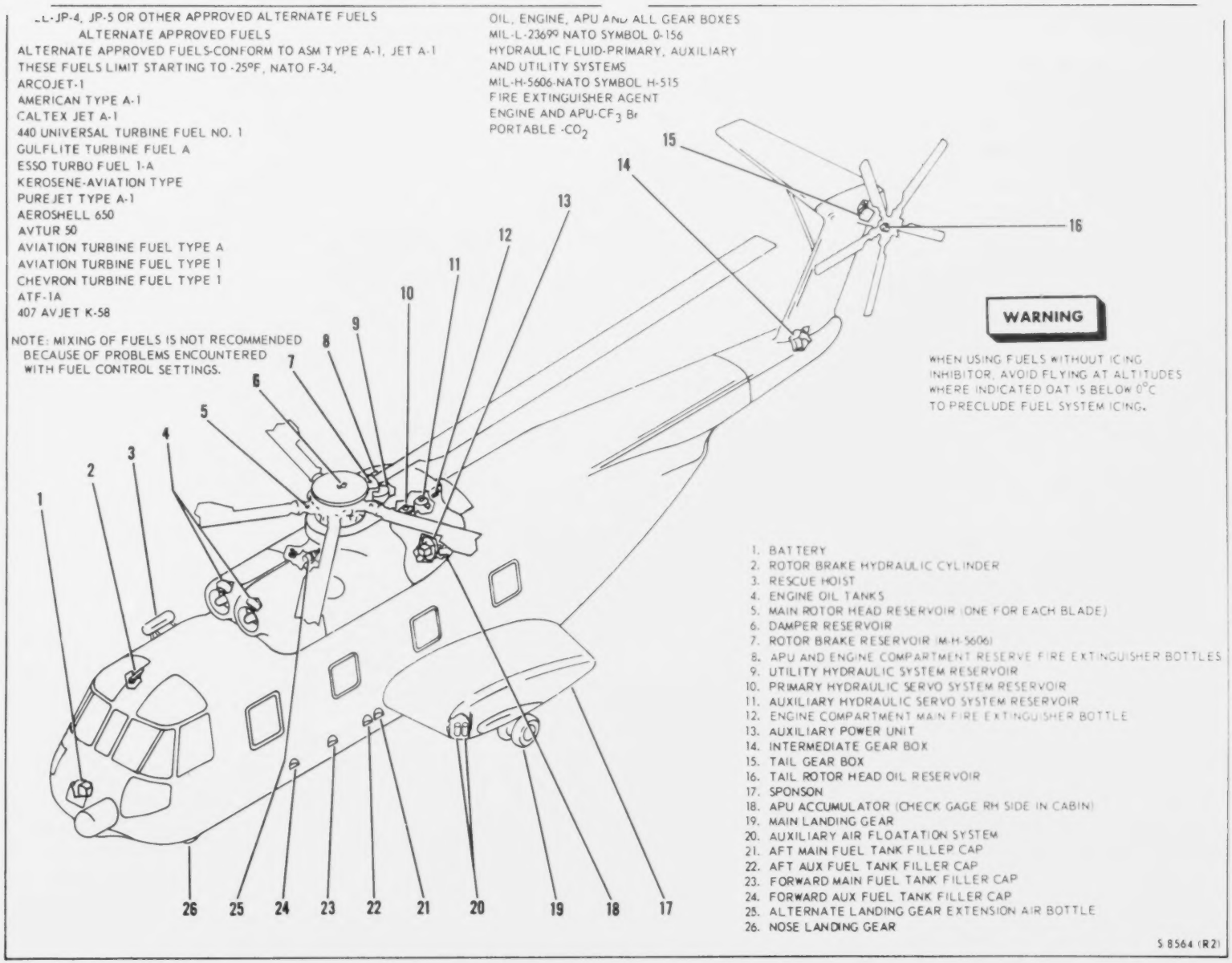

JP-4, JP-5 OR OTHER APPROVED ALTERNATE FUELS
ALTERNATE APPROVED FUELS
ALTERNATE APPROVED FUELS-CONFORM TO ASM TYPE A-1, JET A-1
THESE FUELS LIMIT STARTING TO -25°F, NATO F-34,
ARCOJET-1
AMERICAN TYPE A-1
CALTEX JET A-1
440 UNIVERSAL TURBINE FUEL NO. 1
GULFLITE TURBINE FUEL A
ESSO TURBO FUEL 1-A
KEROSENE-AVIATION TYPE
PURE JET TYPE A-1
AEROSHELL 650
AVTUR 50
AVIATION TURBINE FUEL TYPE A
AVIATION TURBINE FUEL TYPE 1
CHEVRON TURBINE FUEL TYPE 1
ATF-1A
407 AVJET K-58
NOTE: MIXING OF FUELS IS NOT RECOMMENDED BECAUSE OF PROBLEMS ENCOUNTERED WITH FUEL CONTROL SETTINGS.
OIL, ENGINE, APU AND ALL GEAR BOXES
MIL-L-23699 NATO SYMBOL O-156
HYDRAULIC FLUID-PRIMARY, AUXILIARY AND UTILITY SYSTEMS
MIL-H-5606-NATO SYMBOL H-515
FIRE EXTINGUISHER AGENT
ENGINE AND APU-CF_3Br
PORTABLE -CO_2
WARNING
WHEN USING FUELS WITHOUT ICING INHIBITOR, AVOID FLYING AT ALTITUDES WHERE INDICATED OAT IS BELOW 0°C TO PRECLUDE FUEL SYSTEM ICING.
1. BATTERY
2. ROTOR BRAKE HYDRAULIC CYLINDER
3. RESCUE HOIST
4. ENGINE OIL TANKS
5. MAIN ROTOR HEAD RESERVOIR (ONE FOR EACH BLADE)
6. DAMPER RESERVOIR
7. ROTOR BRAKE RESERVOIR (MIL-H-5606)
8. APU AND ENGINE COMPARTMENT RESERVE FIRE EXTINGUISHER BOTTLES
9. UTILITY HYDRAULIC SYSTEM RESERVOIR
10. PRIMARY HYDRAULIC SERVO SYSTEM RESERVOIR
11. AUXILIARY HYDRAULIC SERVO SYSTEM RESERVOIR
12. ENGINE COMPARTMENT MAIN FIRE EXTINGUISHER BOTTLE
13. AUXILIARY POWER UNIT
14. INTERMEDIATE GEAR BOX
15. TAIL GEAR BOX
16. TAIL ROTOR HEAD OIL RESERVOIR
17. SPONSON
18. APU ACCUMULATOR (CHECK GAGE RH SIDE IN CABIN)
19. MAIN LANDING GEAR
20. AUXILIARY AIR FLOATATION SYSTEM
21. AFT MAIN FUEL TANK FILLER CAP
22. AFT AUX FUEL TANK FILLER CAP
23. FORWARD MAIN FUEL TANK FILLER CAP
24. FORWARD AUX FUEL TANK FILLER CAP
25. ALTERNATE LANDING GEAR EXTENSION AIR BOTTLE
26. NOSE LANDING GEAR
S 8564 (R2)

Figure 3-2. - Servicing diagram.

FULL on the oil level sight gage the gear box contains 0.2 gallons. When the oil in the tail gear box is at FULL on the oil level sight gage, it contains 0.4 gallons.

FUEL SUPPLY SYSTEM

The helicopter is equipped with two independent pressure-type fuel systems, joined together by a crossfeed system to ensure maximum fuel utilization, and two internal auxiliary systems. The two main systems are divided into a forward and aft system and are augmented by the auxiliary systems. The main systems consists of fuel tanks with individual bladder-type cells, collector cans, and ejector units in which two submerged boost pumps are located. The auxiliary systems consist of a forward and aft tank with a bladder-type cell and ejector units. Transfer of fuel from auxiliary to main tanks is controlled by the pilot. The ejector system and boost pump arrangement provides for a minimum of unusuable fuel.

The crossfeed system provides diversified main fuel system operation. The crossfeed system is electrically controlled by a crossfeed valve switch and allows fuel from both main systems to be directed to one engine during single-engine operation, or fuel from one system to supply both engines should the need arise.

Under normal conditions, the forward main system supplies fuel to the No. 1 engine, and the aft main system supplies fuel to the No. 2 engine. All tanks may be filled by either a pressure refueling system or by gravity through conventional filler necks on each tank. Auxiliary tanks may also be refueled through in-flight gravity refueling connections. For fuel specification grade, see figure 3-2.

FUEL TANKS

There are two main fuel tanks and two auxiliary fuel tanks located beneath the cabin floor in the following sequence from nose to tail: forward auxiliary tank, with a capacity of 184 gallons; forward main tank, with a capacity of 348 gallons; aft auxiliary tank, with a capacity of 245 gallons; and aft main tank with a capacity of 345 gallons (figure 3-3).

The forward main tank system, consisting of two cells, contains one collector can, five check valves, two pressure switches, two pump failure caution light circuits, one primary bus powered boost pump, one monitor bus powered boost pump, one flapper valve, one pressure refueling and defueling valve, one fuel ejector unit, one gravity filler, two sump drain valves, one dual high-level sensor, and two float-operated shutoff valves. The aft main tank system, consisting of two cells, contains the same items as the forward main tank except that it has one instead of two float-operated shutoff valves. The fuel boost pumps within each main tank provide fuel to the associated fuel ejectors and the appropriate engine. The boost pumps are located in collector cans.

FUEL QUANTITY DATA

	USABLE		UNUSABLE		FULLY SERVICED	
FUEL TANKS	US GALLONS	POUNDS	US GALLONS	POUNDS	US GALLONS	POUNDS
FWD MAIN	344.6	2239.9	3.48	22.62	348	2262.0
AFT MAIN	342.4	2225.6	2.61	16.96	345	2242.5
FWD AUXILIARY	183.2	1190.8	0.8	5.20	184	1196.0
AFT AUXILIARY	244.2	1587.3	0.8	5.20	245	1592.5
TOTAL	1114.4	7243.6	7.69	49.98	1122.0	7293.0

1. Usable fuel determined at 0 degree nose-down attitude.
2. Fuel density of 6.5 lb/gal (JP-4) at standard day temperature.
3. Gravity refueling method used.

Figure 3-3. - Fuel quantity data.

The fuel level in the collector cans is maintained by ejector and flapper valve action. This fuel ejector unit and boost pump arrangement provides integral fuel transfer within each main tank at all operating attitudes, and provides for a maximum of usable fuel.

The single-cell forward auxiliary fuel tank system contains one check valve, one gravity filler, one fuel ejector, one sump drain valve, one pressure refueling and defueling valve, one dual high-level sensor, one gravity refueling connection in the cabin, and one motor operated gate valve. The single-cell aft auxiliary fuel tank system contains the same items as the forward auxiliary tank system except that it has two check valves, two motor-operated gate valves, and two fuel ejectors. All fuel tank vent lines are routed through the cabin to minimize vent icing, then to both sides of the helicopter, where the tanks are vented to the atmosphere.

FUEL TRANSFER

Three DC motor operated gate valves located in the fuel ejector motive flow lines enable the pilot to have complete control of fuel transfer. Fuel is transferred from auxiliary to main tanks by fuel ejectors; motive flow is obtained from the boost pumps. Fuel in the forward auxiliary tank can be transferred only to the forward main tank. A float-operated shutoff valve prevents overfilling of the forward main tank. Fuel from the aft auxiliary tank can be transferred to either the forward or aft main tank. Float-operated shutoff valves prevent overfilling of either main tank. When either main tank level is above 1,600 pounds, any attempt to transfer fuel will result in a transfer to the auxiliary tank in use due to the inability of the fuel to pass the float-operated gate valve in the respective main tank.

CAUTION

Do not transfer fuel when main tank level is above 1,600 pounds, because fuel may be forced overboard through the auxiliary tank vents if the auxiliary tank fuel level is high.

Fuel Transfer Switches

Two fuel transfer switches are located on the fuel management panel. The switch marked AFT AUX, OFF controls the transfer of fuel from the aft auxiliary tank to the aft main tank. The switch marked FWD AUX, OFF, AFT AUX controls the transfer of fuel from the forward auxiliary tank and the aft auxiliary tank to the forward main tank. The switches are powered by 28 volts DC from the primary bus and are protected by circuit breakers, marked TRANSFER, 1, 2, 3, located on the overhead circuit breaker panel.

NOTE

The position of the fuel transfer lines may cause fuel to feed from the auxiliary to the main fuel tanks without the use of a transfer system. This condition occurs when the fuel level in the auxiliary tank is above the fuel transfer lines and at the same time the fuel level in the main tanks is lower.

FUEL DUMP SYSTEM

Fuel may be dumped at a limited rate from either main tank, or from both main tanks simultaneously, through a single overboard drain located in the trailing edge of the right sponson. Fuel flow is provided by the fuel boost pumps. Two manually operated dump valves, one for each main tank, are located overhead in the forward area of the cabin. The dump system is activated by holding or locking over center one or both of these valves in the open position. Rate of dump from one tank is approximately 80 pounds per minute and from both tanks approximately 160 pounds per minute.

PRESSURE REFUELING SYSTEM

The pressure refueling system consists of one external pressure fueling adapter, four dual high-level sensors, and four pressure refueling and defueling valves, one in each tank. The location of the pressure fueling adapter directly beneath the cabin door permits refueling while the helicopter is in a hover. Each dual high-level sensor contains one primary and one secondary valve, each of which can be solenoid operated during precheck or float operated by fuel level. The shutoff capability of the system is tested by positioning the high-level shutoff switch, located above the fueling adapter, to PRI TEST and SEC TEST independently. This energizes the corresponding solenoids of all four dual high-level sensors. The solenoids raise the floats electrically, which in turn close the pressure refueling/defueling valves, stopping flow into all tanks. When the switches are returned to the OFF position, the floats operate in conjunction with the fuel level of each tank. When each tank reaches full capacity, its dual high-level sensor closes its pressure refueling and defueling valve and stops fuel flow into that tank. Electrical power for the system TEST is supplied by the 28-volt DC primary bus through the HI-LEVEL SHUTOFF TEST circuit breaker on the overhead circuit breaker panel.

PRESSURE DEFUELING SYSTEM

Limited pressure defueling is accomplished by attaching the pressure fueling nozzle to the pressure refueling adapter and applying suction. Fuel will then be drawn from all tanks simultaneously until one of the four tanks is empty. Defueling will then cease from the remaining tanks due to air ingestion from the empty tank. The amount of fuel remaining in the various tanks depends entirely on the initial quantities of fuel in each tank.

ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system consists of an alternating current power supply system and a direct current power supply system. Two permanent magnet generators (PMG) supply 115/200-volt, three phase, 400 Hz AC power to the electrical system. Three transformers provide 26-volt single phase AC power. Both generators also supply 28-volt DC power to the electrical system control circuits. Two converters provide 28-volt DC control and operating power. One battery supplies 24-volt DC power.

ALTERNATING CURRENT POWER SUPPLY SYSTEM

Alternating current power is supplied by two generators designated as No. 1 and No. 2. Associated system components are designated in a similar manner. System operation is automatic, and control switches on the overhead switch panel and monitoring caution-advisory light capsules on the caution-advisor panel are provided. Normally, associated primary and monitored bus loads are assumed by each generator. Primary bus loads are essential for night instrument flight but monitor bus loads are not essential for this type of flight. If either generator fails, its primary bus load is automatically transferred to the remaining generator. With a failed generator, all monitor bus loads are automatically dropped. An AC external power receptacle permits use of an AC external power unit for ground power application.

Supervisory Panels

The supervisory panels, designated No. 1 and No. 2, provide control for all AC relays and one DC relay in the electrical system. When the No. 1 generator is developing normal AC power and the generator switch is placed ON, DC power from the same generator will be used by the No. 1 supervisory panel to close the No. 1 generator contactor relay. Closing the No. 1 generator contactor relay permits the No. 1 generator to power the No. 1 AC primary bus and to deliver 28 volts DC to the AC monitor bus relay. In addition, closing the relay opens the No. 1 generator caution light circuit, causing the light to go out. The No. 2 supervisory panel operates the same way to power the No. 2 AC primary bus and to turn out the No. 2 caution light. DC power from the No. 2 supervisory panel also closes the AC monitor bus control relay, which permits 28 volts DC from the No. 1 supervisory panel to close the DC monitor bus relay and the No. 1 and No. 2 monitor bus contactor relays. Therefore, 28-volt DC power is required from both the No. 1 and No. 2 supervisory panels to energize the AC and DC monitor buses. If either generator fails to produce 28 volts DC, the primary DC bus supplies back-up DC voltage to each supervisory panel through circuit breakers. The circuit breakers, located on the overhead circuit breaker panel, are marked 1 and 2 under the general headings PMG BACKUP.

The supervisory panels provide protection for the electrical system. AC power delivered to the panel-from its associated generator is monitored by the panel for open phase, overvoltage, and undervoltage at all times. The panel monitors for underfrequency when the helicopter is on the ground with its main landing gear struts compressed activating the scissor switches. If any of the monitored conditions are not normal, the generator contactor relay will open, taking the associated generator off the line, deenergizing all monitor buses, and illuminating the associated generator caution light. If a generator fails, primary AC bus loads will be switched automatically to the remaining generator.

NOTE

Should a low-voltage condition occur in either generator, there will be a 6-second delay before the load is shifted to the other generator.

Generators

Two 115/200-volt, 3-phase, 400 Hz, PMG, AC generators are mounted on and are driven by the accessory section of the main gear box. Generator output varies with temperature and altitude (approximately 20 KVA at sea level to 25 KVA at 15,000 feet altitude). Generator AC voltage is delivered to the associated supervisory panel and generator contactor relay. The permanent magnet sections of the generators also develop DC power to be used in the control circuits. This DC power is delivered to the associated supervisory panel. The auxiliary power unit (APU) drives the generators through the main gear box accessory section when the rotor rpm is below 100% N_r. When the

rotor speed reaches 100% N_r, the accessory section is driven through the main gear box.

GENERATOR SWITCHES: The generator switches are located on the overhead switch panel under the general heading 1 GEN 2 and have marked positions ON-OFF, RESET-TEST. Placing the switch in the ON position puts the respective generator on the line by closing the generator contactor relay. The OFF-RESET position turns the generator off and resets the cycle. The TEST position is only used for maintenance.

GENERATOR CAUTION LIGHTS: Two generator caution lights, marked 1 GEN and 2 GEN respectively, are located on the caution-advisory panel. These lights will illuminate whenever the associated generator is taken off the line by opening the generator contactor relay, which causes the caution light circuit to be completed. The generator caution lights are powered by the DC primary bus and are protected by circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked No. 1 and No. 2 under the general headings GENERATOR and INDICATOR LTS.

Autotransformers

Three autotransformers in the AC system convert 115-volt power from the primary AC buses to 26 volts. Two of the autotransformers are powered by the No. 1 primary bus and are protected by circuit breakers in the copilot's overhead circuit breaker panel, marked 26 V XMFR and RADIO XMFR 26V ØB under the general heading No. 1 AC PRI. The autotransformer protected by the circuit breaker, marked 26V XMFR, supplies 26 volts AC to the copilot's course indicator azimuth card, copilot's ID-250 RMI card, primary hydraulic pressure gage, transmission oil pressure gage, and the No. 1 engine torque sensor and oil pressure gages. The autotransformer protected by the circuit breaker, marked RADIO XMFR 26V ØB, supplies 26 volts AC to:

1. Pilot's course indicator azimuth card
2. Pilot's ID-250 RMI card
3. Both pilot's ID-250 needles
4. TACAN AN/ARN-118 azimuth and DME
5. Doppler radar (AN/APN-175(V)-1)
6. Heading information to the navigation computer and VOR inputs to the AN/AYN-2 computer

The third autotransformer is powered by the No. 2 primary bus and is protected by a circuit breaker in the pilot's overhead circuit breaker panel. The circuit breaker is marked 26V XMFR under the general heading NO. 2 AC PRI. This autotransformer supplies 26 volts AC to operate the auxiliary and utility hydraulic pressure gages and the No. 2 engine oil pressure and torque sensor gages.

On helicopters modified by T.C.T.O. 1H-3(H)F-536 and CG No. 1487 and subsequent, two radio autotransformers are installed to provide a redundant source of 26 volts AC power for the navigation instruments. The output of each autotransformer is applied to the contacts of the RADIO XFMR switch on the overhead switch panel. The switch selects either the No. 1 or the No. 2 autotransformer output to energize the transformer fail relay and the NAV and PILOT circuit breakers. Should the relay become de-energized, 28 volts DC from the RADIO XMFR CAUT circuit breaker is applied to the caution/advisory panel, illuminating the RADIO XFMR caution capsule to indicate loss of 26 volts AC from the selected autotransformer.

AC Utility Power Receptacles

Two 115-volt AC 400-Hz utility receptacles are provided. The receptacles receive power from the No. 1 AC monitor bus through two circuit breakers on the copilot's overhead circuit breaker panel. The circuit breakers are marked CABIN and XMSN under the general headings UT RECP and NO. 1 AC MON.

Alternating Current Circuit Breakers

Alternating current circuit breakers are located on the pilot's and copilot's overhead circuit breaker panels.

DIRECT CURRENT POWER SUPPLY SYSTEM

Direct current power is supplied by two 28-volt, 200-ampere converters, designated as No. 1 and No. 2, which are powered by respective No. 1 and No. 2 AC primary buses. The DC system operation is automatic, and control switches and converter caution lights are provided. Normally, primary and monitor bus loads are assumed by both converters. Primary bus loads are essential for flight under night instrument conditions, but monitor bus loads are not essential for this type of flight. If one converter fails, the associated reverse current cutout relay will remove the failed converter from the DC primary bus. The remaining converter will assume the DC primary bus loads, and the DC monitored bus loads will be dropped. The battery can provide power to the DC primary bus when no other source is available. The DC external power receptacle and associated circuitry permit use of an external power unit for ground power application.

Converters

Two 200-ampere, 28-volt DC converters are located in the electronics compartment. The converters require an AC input from the generators or from an AC external power source. The two converters are designated as No. 1 and No. 2, and the associated components are designated in a similar manner. Both converters normally supply power to the DC primary bus. The DC primary bus supplies power to the DC monitor bus. The No. 1 converter receives three-phase power from the No. 1 AC primary bus, and the No. 2 converter receives three-phase power from the No. 2 AC primary bus. The AC input is stepped down, rectified, and filtered within each converter, and the DC output is fed to the associated reverse current cutout relay. During normal operation, DC power from the reverse current cutout relay is fed to the DC primary bus. If either converter or either AC generator fails, the monitor bus is automatically dropped from the line, and an appropriate caution light will illuminate. The reverse current cutout relay prevents current flow from the DC primary bus to a failed converter. The DC monitor bus relay must be closed for the monitor bus to receive power. Power to close this relay comes from the DC primary bus and is routed through the No. 2 and No. 1 reverse current cutout relays. If either converter, either reverse current cutout relay, or either AC generator is inoperative (or if either converter switch is OFF), the DC monitor bus will be dropped from the line. The No. 1 converter is protected by a circuit breaker on the copilot's overhead circuit breaker panel. The circuit breaker is marked No. 1 CONVERTER under the general heading No. 1 AC PRI. The No. 2 converter is protected by a circuit breaker on the pilot's overhead circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked No. 2 CONVERTER under the general heading No. 2 AC PRI.

CONVERTER SWITCHES: The converter switches, located on the overhead switch panel under the general heading 1 CONVERTER 2, have marked positions ON and OFF.

CONVERTER CAUTION LIGHTS: Two converter caution lights, marked #1 CONV and #2 CONV, are located on the caution-advisory panel. Failure of a converter, or reverse current cutout relay (or turning a converter switch OFF), will illuminate the associated caution light.

Battery

A 24-volt, 22-ampere-hour nickel cadmium battery, located in the nose section forward of the pilot's compartment, is accessible from outside the helicopter. Battery power is used for limited ground operations, when no external power is available, and as an emergency source of power to the DC primary bus. The battery bus is continually energized and provides power for the anchor lights. The battery bus is connected to the DC primary bus when the battery switch is ON.

BATTERY SWITCH: The battery switch, located on the overhead switch panel, is labeled BATTERY, with positions marked ON and OFF.

DC Utility Power Receptacle

Three 28-volt DC utility receptacles are installed. The receptacles receive power from the DC monitor bus through three circuit breakers on the pilot's overhead circuit breaker panel. The circuit breakers are marked COCKPIT, CABIN, and XMSN under the general headings UT RECEPTACLE, MON, and DC.

Direct Current Circuit Breakers

Direct current circuit breakers are located on all three overhead circuit breaker panels and on the battery bus circuit breaker panel.

EXTERNAL POWER

External Power Switch

The external power switch is located on the overhead switch panel, under the heading EXT PWR, with positions marked ON and OFF. The external power switch is protected by a circuit breaker on the overhead circuit breaker panel, marked EXT PWR under the general heading DC PRI BUS.

EXTERNAL POWER ADVISORY LIGHT: The external power advisory light, located on the caution-advisory panel and marked EXT POWER, will illuminate when the external power switch is ON and external power is being supplied to the aircraft.

AC EXTERNAL POWER: An AC external power receptacle, located on the left side of the fuselage aft of the sponson, is used to connect 115/200-volt, 3-phase, 400-Hz power to the helicopter. A phase sequence relay is incorporated to sense proper external power phase rotation. When the phase rotation is correct, the EXT PWR switch is ON, and the BATT switch is ON, 3-phase power will be admitted to the aircraft, and the AC systems will function normally. The battery switch must be ON to power the DC primary bus, and the external power switch must be ON to permit the DC primary bus to supply control power to the phase sequence relay. With the converter switches ON, the DC monitor bus control relay

and the DC monitor bus relay will close, and the DC power system will function normally. At this point, the battery switch should be turned OFF to avoid possible overcharging of the battery.

DC EXTERNAL POWER: A DC external power receptacle, located on the right side of the fuselage below the pilot's window, is used to connect 28 volt-DC power to the helicopter. With the external power switch ON, 28-volt DC power from an external power source is delivered through the DC power receptacle to illuminate the external power advisory light, close the external power relay, energize the DC primary bus, and close the DC monitor bus relay, providing power to the DC monitor bus.

CAUTION

When securing either AC or DC external power, secure the EXT PWR switch before removing the power cables to prevent possible arcing and damage to the external power receptacles.

UTILITY HYDRAULIC SUPPLY SYSTEM

The utility hydraulic supply system provides hydraulic pressure for all hydraulic equipment not included in the flight control servo hydraulic systems. The utility hydraulic system reservoir (9, figure 3-2), located aft of the main gear box, has a capacity of 3.05 gallons of hydraulic fluid. The utility hydraulic pump is located on the accessory drive section of the main gear box and provides 3,000 psi hydraulic pressure. An oil cooler is provided in the hydraulic line to maintain utility hydraulic oil temperatures within limits. The blower in the oil cooler operates on power from the No. 1 AC primary bus, and the control relay is actuated by power from the DC primary bus. The blower operates continuously when these busses are energized. The utility hydraulic system operates the main landing gear, nose landing gear, APU start system, ramp actuating system, and the rescue hoist.

UTILITY HYDRAULIC PRESSURE INDICATOR

The utility hydraulic pressure indicator, located on the instrument panel, operates on 26-volt AC power from an autotransformer. The gage, marked UTI, indicates pressure in the utility hydraulic system in psi. The indicator receives electrical power from the No. 2 AC primary bus through a circuit breaker on the pilot's AC circuit breaker panel. The circuit breaker is marked UT under the heading HYD PRESS IND.

SELF QUIZ #3

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. To check the main gear box oil level, you should use a/an _____.

A. oil quantity gage in the cockpit
B. oil quantity gage on the gear box
C. sight gage on the lower left side of the main gear box housing
D. sight gage on the lower right side of the main gear box housing

2. The augmented main gear box oil system will permit the helicopter to continue operating for approximately _____ minutes if there is a failure in the main lubrication system.

A. 15
B. 30
C. 45
D. 60

3. What is the HH-3F's total fuel capacity in gallons?

A. 988
B. 1,044
C. 1,088
D. 1,122

4. Before pressure refueling the HH-3F, you must ensure that the _____ will operate correctly.

A. motor operated shutoff valve
B. high-level shutoff valve
C. float valve
D. boost pump

5. What terminates an HH-3F pressure defueling operation?

A. A tank becoming empty
B. Low-level warning actuation
C. The high-level shutoff valve
D. Pressure fueling valve actuation

6. The primary bus provides power for all components that are essential for _____ flight operations.

A. SAR
B. night VFR
C. night instrument
D. any

7. If the No. 1 generator fails, you should expect to lose all components powered by the _____ bus.

A. No. 1 primary AC
B. No. 1 AC monitor
C. primary DC
D. No. 2 primary AC

8. Assume that the No. 2 converter fails. Which buses will be dropped from the line?

A. No. 1 AC primary
B. DC primary
C. DC monitor
D. No. 2 DC primary

9. The utility hydraulic system operates at _____.

A. 750 psi
B. 1,500 psi
C. 1,750 psi
D. 3,000 psi

ANSWERS TO SELF-QUIZ #3

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	3-2
2	C	3-2
3	D	3-4
4	B	3-5
5	A	3-6
6	C	3-6
7	B	3-6
8	C	3-8
9	D	3-9

HH-3F FLIGHT SYSTEMS

Reading Assignment:
Pages 4-1 through 4-13

9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Flight control systems: Main and tail rotor.
2. Flight control hydraulic control systems.
3. Automatic flight control (AFCS) and coupler systems.
4. Magnetic compass, free air temperature gage, clocks, pilot-static system, vertical velocity indicators.
5. Heading attitude reference system (HARS).
6. Caution-advisory panel.
7. Landing gear system.
8. Brake system.
9. Ramp system and cargo door.

FLIGHT CONTROL SYSTEMS

The flight control system is divided into three systems: the main rotor flight control system, the tail rotor flight control system, and the flight control hydraulic supply systems. When the automatic flight control system and coupler system are engaged, they provide corrections of limited authority to the flight control system, causing the helicopter to respond in a stable manner to the maneuver called for by the position of the cyclic stick or referenced ground speed from AFCS control panel drift pots. This equipment also provides a constant altitude. The description and operation of the automatic flight control system and coupler system are included in the paragraphs, AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) AND COUPLER SYSTEM in this section. A cyclic stick trim system is installed.

MAIN ROTOR FLIGHT CONTROL SYSTEM

The main rotor flight control system provides both vertical, lateral, and longitudinal control. Control motions are sent from the collective pitch lever for vertical control, and from the cyclic stick for lateral and longitudinal control. The motions are combined in a mixing unit, located in the AFCS control compartment aft of the pilot's seat, and are transmitted to the main rotor assembly by mechanical linkage. Control action is assisted by two hydraulically operated flight control servo systems. The main rotor flight controls terminate at the stationary swashplate of the main rotor head. Control action is transmitted through the rotating swashplate and linkage on the main rotor hub to the blades.

Collective To Yaw Coupling

A collective to yaw coupling, located in the mixing unit, provides automatic tail rotor blade angle

changes to compensate for changes in collective pitch settings. In flight, the coupling is irreversible in that collective pitch motion will act to displace the tail rotor but tail rotor pedal motion will not affect main rotor collective pitch blade angle.

Collective To Cyclic Coupling

A bias in the collective to cyclic coupling is incorporated in the mixing unit to apply a slight left roll correction when the collective pitch is increased.

Collective Pitch Levers

Two collective pitch levers are located in the pilot's compartment. Both levers operate simultaneously to change the collective pitch of the main rotor blades. A friction lock on the pilot's collective pitch lever can be rotated to apply friction to prevent the collective pitch levers from creeping while in flight.

Cyclic Sticks

The cyclic sticks provide lateral and longitudinal control of the helicopter. Moving the cyclic stick in any direction tilts the tip path plane of the main rotor blades in that direction and moves the helicopter in the same direction. The stick grip (figure 4-1) contains pushbutton and thumb-operated switches for controlling various equipment installed in the helicopter.

Figure 4-1. - Cyclic stick grip.

Cyclic Stick Trim System

The cyclic stick trim system holds the stick in a selected trim position. Two actuators are hydraulically powered by the auxiliary servo system and energized electrically from the DC primary bus. One actuator positions the cyclic stick laterally, and the other positions the cyclic stick fore and aft. The actuators are operated by a four-way cyclic trim switch mounted on both the pilot's and copilot's cyclic stick grips. To trim the cyclic stick, the cyclic trim switch is pushed in the direction of desired cyclic stick movement, causing the actuators to move the stick until the cyclic trim switch is released. The cyclic stick may be manually displaced from the trimmed position against a resistance force caused by spring compression, which increases progressively with stick displacement. The spring action provides cyclic stick feel and amounts to approximately 1.5 pounds initial force, plus 0.5 pounds for each 1 inch of cyclic stick displacement. When the pressure on the cyclic stick is released, spring action returns the stick to the original trim position. The cyclic stick trim system will operate as long as there is both DC power to the primary bus and auxiliary hydraulic pressure to the actuators.

CYCLIC STICK TRIM MASTER SWITCH: A cyclic stick trim master switch, marked STICK TRIM MASTER, ON, and OFF, is located on the overhead switch panel. When the switch is ON, the cyclic stick is held in position. When the switch is OFF, the force gradient system is inoperative, and the cyclic trim system will not maintain the position of the stick.

CYCLIC (BEEPER) TRIM SWITCHES: The cyclic trim switches, located on the pilot's and copilot's cyclic stick grips (figure 4-1), have marked positions FWD, AFT, L, and R. The four-way thumb switch is spring-loaded to the center (off) position. When the switch is placed in any of the four positions, hydraulic pressure will drive the cyclic stick in the same direction. Release of the switch stops stick motion. The action of the cyclic stick trim system will then function about this location of the cyclic stick. The cyclic trim switches receive electrical power from the DC primary bus through a circuit breaker marked BEEPER-TRIM, located on the overhead DC circuit breaker panel.

CYCLIC TRIM RELEASE BUTTON: The spring-loaded, pushbutton switches are located on the pilot's and copilot's cyclic stick grips (figure 4-1) and marked TRIM REL. Cyclic trim position can be changed by depressing the cyclic trim release button, manually moving the stick to the new position, and then releasing the cyclic trim release button.

The cyclic trim system will then hold the new selected position of the cyclic stick. The cyclic trim release button controls DC primary bus power to the trim actuators.

TAIL ROTOR FLIGHT CONTROL SYSTEM

The functions of the tail rotor flight control system are to compensate for main rotor torque and to provide a means for changing the heading of the helicopter. The torque developed by the main rotor blades turning counterclockwise tends to rotate the fuselage in a clockwise direction. Any change in power setting will vary the amount of main rotor torque. To compensate for torque variations, the pitch and resulting thrust of the tail rotor blades can be increased or decreased. Turns are accomplished by increasing tail rotor thrust, which overcompensates for main rotor torque and changes the heading of the fuselage to the left, or by decreasing the tail rotor thrust, which undercompensates for the main rotor torque and changes the heading of the fuselage to the right.

Tail rotor control pedal movements are transmitted to the tail rotor assembly by mechanical linkage and cables. Control action is assisted by the auxiliary servo system only. A hydraulic damping device incorporated in the auxiliary servo resists abrupt movements of the pedals, which could cause sudden yaw acceleration and possible damage to the helicopter. The pedal damper is inoperative when the auxiliary servo system is inoperative or shut off. Yaw compensation is accomplished by mechanical linkage in the mixing unit, which automatically changes tail rotor blade angles for changes in collective pitch without moving the pedals. A tail rotor negative force gradient system is installed to relieve the pilot of tail rotor forces created by aerodynamic loads when the auxiliary servo system is inoperative. Because of this, when the system is checked on the ground with tail rotor stationary and the auxiliary servo off, a negative spring centering effect is created. The normal tendency of the pedals is then to go to either extreme. Under these conditions, considerable force is required to push the pedals from the extreme position; however, the force will decrease as the neutral pedal position is approached. The initial force to move the pedals from either extreme position is 30 to 40 pounds.

Tail Rotor Pedals

The tail rotor pedals change the pitch and thrust of the tail rotor and consequently the heading of the helicopter. Electrical switches, mounted on the pedals, null the directional signals of the automatic flight control system when feet are placed on the pedals. Toe brake pedals for the main landing gear wheel brakes are mounted on both the pilot's and copilot's pedals.

TAIL ROTOR PEDAL ADJUSTMENT KNOBS: Pedal adjustment knobs are located on each side of the fuselage, just forward of the ash trays in the pilot's compartment. The adjustment knobs are connected to mechanical linkages that provide for fore-and-aft adjustment of the pedals. The knobs are rotated to the right, as indicated by the arrow marked FWD, for forward adjustment and to the left, as indicated by the arrow marked AFT, for aft adjustments. Adjustments should be made with feet away from the pedals to avoid damage to the adjustment cables striker plates or microswitches.

FLIGHT CONTROL HYDRAULIC SYSTEM

A primary and an auxiliary flight control servo hydraulic system provides power boost to operate the controls. The servos also prevent feedback of rotor system vibratory loads to the controls. Each servo system operates from an independent hydraulic system and uses similar servo hydraulic units to vary the main and tail rotor blade pitch through the mechanical linkage of the flight control system. The servo unit output is connected to the flight control linkage to provide power boost. The continuity of the direct control linkage is maintained from the controls in the pilot's compartment through the auxiliary and the primary servos to the main rotor blades, except for a slight amount of end play at each servo unit to permit the pilot valves to move before the direct control linkage. Normally, both servo systems are in operation.

Primary Flight Control Servo System

The primary flight control servo system consists of three hydraulic servo units which connect the flight control linkage to the stationary swashplate of the main rotor assembly. All three servo units respond simultaneously and move in the same direction in response to movements of the collective. Two of the servo units (lateral servo units) respond simultaneously, but move in opposite directions in response to lateral movements of the cyclic stick. One of the servo units (fore-and-aft servo unit) responds to the fore-and-aft movements of the cyclic stick. Since all three movements can occur simultaneously through the action of the mixing unit, the position of any primary servo unit is the result of the combined input of the cyclic stick and collective. This results in a primary servo system in which any one servo may have an effect on both collective pitch and cyclic (lateral or fore-and-aft) pitch. The servos provide power boost only to the main rotor flight

control system. The primary servo hydraulic pump is driven by the accessory section of the main gear box. The primary hydraulic system reservoir, mounted aft of the main gear box, has a capacity of approximately 0.45 gallon of hydraulic oil. A light on the caution panel, marked PRI SERVO PRESS, illuminates when primary servo pressure fails.

Auxiliary Flight Control Servo System

The auxiliary flight control servos, consisting of a bank of four hydraulic servo units, are located between the pilot's controls and the flight control system mixing unit. Each control input acts independently on the corresponding auxiliary servo. The collective positions the collective servo. The cyclic stick positions either, or both, the fore-and-aft servo and the lateral servo. This results in an auxiliary servo system in which only one servo has an effect on collective pitch, one on fore-and-aft cyclic pitch, and one on lateral cyclic pitch. They provide power boost to both the main and tail rotor flight control systems and the means of introducing AFCS corrective signals into the flight control systems. The auxiliary servo hydraulic pump is driven by the main gear box accessory section. The auxiliary hydraulic system reservoir, located aft of the primary hydraulic system reservoir, has a capacity of approximately 0.45 gallon of hydraulic oil. A light on the caution panel, marked AUX SERVO PRESS, illuminates when auxiliary servo hydraulic pressure fails.

Flight Control Servo Switches

The primary and auxiliary flight control servo systems are controlled by the servo switches, marked SERVO, located on the pilot's and copilot's collective pitch lever grip. The marked switch positions are PRI OFF and AUX OFF. Both servo systems are normally in operation with both switches in the unmarked center (ON) position. To turn off the primary servos, place either of the switches in the forward (PRI OFF) position. To turn off the auxiliary servos, place the switch in the aft (AUX OFF) position. The systems are interconnected electrically in such a way that regardless of switch position, it is impossible to turn either system off unless there is 1,000 psi in the remaining system. The servo shutoff valves operate on current from the DC primary bus. Protection is provided by circuit breakers on the overhead DC circuit breaker panel. The circuit breaker is marked PRI and AUX under the heading SERVO CUTOFF.

Servo Hydraulic Pressure Indicators

The primary and auxiliary servo hydraulic pressure indicators, located on the instrument panel, operate on 26 volts AC from the autotransformers powered by the AC primary buses. The primary hydraulic pressure indicator is protected by a circuit breaker on the copilot's overhead circuit breaker panel. The circuit breaker is marked PRI under the heading HYD PRESS IND. The auxiliary hydraulic pressure indicator is protected by a circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked AUX under the heading HYD PRESS IND.

Primary and Auxiliary Servo Pressure Caution Lights

The primary and auxiliary servo pressure caution lights, marked PRI HYD PRESS or AUX HYD PRESS, are located on the caution panel. When servo pressure in either system drops below 1,000 psi, the associated light will illuminate.

AUTOMATIC FLIGHT CONTROL (AFCS) AND COUPLER SYSTEMS

The automatic flight control system (AFCS) provides added stability in pitch, roll, and yaw, plus attitude, heading, and altitude hold. The coupler system is used in conjunction with the AFCS for hovering operations when accurate ground speed and altitude control is desired.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The AFCS used in this helicopter differs from the autopilot used in fixed-wing aircraft in that the AFCS may be engaged at all times, has less control authority than the primary flight control system, and may be easily overridden through normal use of the flight controls. The pilot has direct control of the system at all times and can engage or disengage the entire AFCS or any channel, as desired, by means of switches on the AFCS control panel, channel monitor panel, cyclic sticks, and collective pitch levers. The AFCS indicators provide the pilot and copilot with visual indication of all AFCS signals.

The AFCS has two modes of operation: (1) Attitude and directional stabilization, and (2) barometric altitude hold. Attitude and directional stabilization is controlled through the pitch, roll, and yaw channels, and barometric altitude hold is controlled through the collective channel. The AFCS is capable of maintaining the barometric altitude of the helicopter within $\pm$ 25 feet or 5% of the altitude, whichever is greater, during straight unaccelerated flight, or when hovering out of ground effect by using barometric altitude reference.

In the pitch and roll channels, the fuselage attitude is held constant by comparing the actual attitude signal received from the vertical gyro with the reference attitude signal received from the cyclic stick position sensor. Automatic pitch and roll attitude stability correction occurs any time the helicopter is displaced from the reference attitude. Pitch and roll gyro information source is selected on the channel monitor panel.

In the yaw channel, the helicopter is held constant by comparing actual heading signals received from the A/A24G-39 HARS heading reference system with reference heading signals received from the YAW TRIM knob and the yaw synchronizer. While the pilot establishes a reference heading by use of the pedals, the yaw channel is placed in a synchronizing mode, the yaw rate gyro develops a signal proportional to the manual heading displacement rate of the helicopter. This signal initiates an open-loop spring condition that produces a proportional feedback force at the pedals. As the pilot presses either pedal, he feels the proportional feedback force opposing the pedal pressure applied. The feedback force remains until the pilot has established the new reference heading. Heading stability correction occurs any time the helicopter is displaced from the desired reference heading.

In the collective channel, the altitude of the helicopter is held constant by signals developed from the altitude controller, which sense changes in barometric pressure from the engage point. Automatic barometric altitude stability correction occurs any time the helicopter is displaced up or down from the reference altitude.

AFCS utilizes power from the No. 1 AC primary bus and the DC primary bus. A thermal time delay relay is incorporated to allow approximately 120 seconds for the vertical gyros to reach a stabilized state before DC power is applied to the system. The AFCS ENG button may then be depressed to engage the pitch, roll, and yaw channels. The collective channel is engaged by depressing the BAR ALT ENG button. With BAR ALT engaged, collective friction should be removed so as not to inhibit collective movement. AC power to the AFCS is protected by circuit breaker panel. The circuit breakers are marked ØA and ØB under the general heading of AFCS. DC power to the AFCS is protected by a circuit breaker, marked AFCS, on the overhead circuit breaker panel.

Automatic Flight Control System Control Panel

The AFCS and coupler controls are located on the panel, marked AFCS CONTROL PANEL, mounted on the center console between the pilot and copilot. Five Pushbutton switches, marked AFCS, BAR ALT, CPLR, BAR OFF and HOVER TRIM ENG are located on the AFCS control panel. All except BAR OFF illuminate when engaged. When the AFCS button is pressed, the pitch, roll and yaw channels become operative. Pressing the BAR ALT button engages the barometric altitude controller. Pressing the CPLR button engages the cylic and collective coupler, if the coupler control switches are both on. In addition, the barometric controller will be engaged if the collective coupler switch is ON. Pressing the button marked HOVER TRIM ENG energizes the hover trim panel, illuminating the button and a red engage light on the top of the hover trim stick. The fifth pushbutton, marked BAR OFF, is used for permanent disengagement of the barometric altitude controller, provided the collective coupler is not engaged. The barometric altitude controller can be released momentarily by pressing and holding the button marked BAR REL on the pilot's or copilot's collective stick grips. Hover trim is disengaged by disengaging the coupler or by cycling the cyclic coupler control switch to OFF then ON. Two coupler control switches are provided for individual operation of the cyclic or collective channels of the coupler when it is engaged.

The five remaining controls are knobs used for trimming various systems. The knobs are designed with characteristic shapes to enable identification by touch. Specific knobs and their identifying shapes and markings are as follows: DRIFT, bar shape; CG TRIM, clover leaf shape; SPEED, indented circle shape; YAW trim, triangular shape; ALTITUDE, cross shape. The DRIFT knob allows the pilot to control the lateral drift of the helicopter with approximately a ± 10-knot ground speed authority when the cyclic coupler is engaged. The CG TRIM knob is used to trim the pitch channel of AFCS for actual cg location. The SPEED knob allows the pilot to control the forward and aft ground speed with approximately a ± 10-knot authority when the cyclic coupler is engaged. The YAW trim knob enables the pilot to make small heading corrections in forward flight with the yaw channel of AFCS engaged. In a hover, the knob may be used for larger heading changes. One rotation of the knob turns the helicopter approximately 72 degrees. The ALTITUDE knob allows the pilot to accurately select hovering altitudes and make altitude changes between zero and 200 feet. The knob has a graduated scale from zero to 200 feet with increments of 5 feet.

Automatic Flight Control System Caution Light

An AFCS caution light marked AFCS OFF is on the caution panel. When the AFCS is disengaged, the light will come on.

CHANNEL MONITOR PANEL

The channel monitor panel, located on the starboard side of the cockpit underneath the pilot's window, provides switches that enable individual disengagement of the channels of AFCS, switches for minor testing, a switch to select gyro input to the AFCS, and a switch to select the inputs to the hover indicators. The channel disengage switches, located in the forward row, enable the pilot to disengage individual channels as desired. The four hardover switches enable technicians to introduce hardover signals to the individual AFCS channels. The channel monitor test switch, located on the overhead switch panel, must be in the TEST position to power the hardover switches. The switches are protected by red safety covers that should be in the down position for flight. The gyro selector switch enables the pilot to select either the port or starboard gyro for pitch and roll inputs to the AFCS. The port gyro position selects the A/A24G-39 HARS gyro and is normally selected for flight. The starboard gyro position selects the 1080Y gyro. The meter selector switch enables either AFCS or coupler inputs to be monitored on the hover indicators when they are in the A mode.

NOTE

The position of the gyro selector switch has no effect on the inputs to the pilot's or copilot's AYN-2 flight director system or the yaw channel or AFCS.

MAGNETIC COMPASS

A standby compass, located on the right side frame of the center windshield above the instrument panel, is marked TO BE USED AS A STBY COMPASS ONLY. A light switch is located at the lower right of the compass. A standby compass correction card is located at the upper right of the compass.

FREE AIR TEMPERATURE GAGE

The free air temperature indicating system consists of a gage, marked FREE AIR, and a temperature sensing bulb. The temperature sensing bulb, extending through the center windshield above the instrument panel, is a direct reading instrument calibrated in degrees Centigrade.

CLOCKS

Three eight-day, 12 hours clocks are installed in the helicopter; two on the instrument panel, and one at the avionicsman's positions.

PITOT-STATIC SYSTEM

There are two pitot-static systems. The pitot portion of the pilot's and copilot's systems are independent of each other, but the static portion of each system is common. Each pitot-static pressure system consists of a heated pitot-static tube, altimeter, airspeed and vertical velocity indicator. The pitot and static lines both originate at the pitot-static tubes. The opening at the head of the tubes furnishes ram air pressure, and ports near the center of the tubes furnish static pressure. The static system vents the airspeed, altimeter, and vertical velocity indicators to atmospheric pressure. The pitot-static tube on the right side of the cockpit canopy furnishes ram air pressure to the pilot's airspeed indicator and static pressure to the common static system. The pitot tube on the right side of the cockpit canopy also furnishes pitot and static pressures to the true airspeed transducer. The pitot-static tube on the left side of the cockpit canopy furnishes ram air pressure to the copilot's airspeed indicator and static pressure to the common static system. Capped tees in the lines in the electronics compartment and in the cabin permit draining moisture from the lines. The AFCS barometric altitude control sensing unit is connected into the common static system. Resistance-type heaters in the pitot-static tubes, controlled by the PITOT HEAT switch on the overhead control panel, prevent formation of ice at the openings. Power for the pitot-static tube heaters is supplied by the DC primary bus system, through the circuit breakers marked, ICE PROTECTION, PITOT HEAT 1 and 2, on the overhead circuit breakers panel.

VERTICAL VELOCITY INDICATORS

Two vertical velocity indicators, located on the instrument panel, indicate the rate of ascent or descent up to 3,000 fpm. The vertical velocity indicators use the same static source as the altimeter.

HEADING ATTITUDE REFERENCE SYSTEM (HARS)

A/A24G-39 FUNCTIONAL DESCRIPTION

The A/A24G-39 is comprised of a displacement gyroscope, an electronic control amplifier, a compass system controller, and a HARS coupler. The displacement gyroscope consists of vertical and directional gyros mounted in multiple gimbals. The electronic control amplifier contains an azimuth servo amplifier, slaving amplifier, deviation compensator, turn and acceleration control features, fast synchronization circuitry, and associated power supplies. It also functions as a system interconnection box. The compass system controller includes a function selector switch, synchronizer and heading set, latitude correction controller, and synchronizing indicator.

The HARS coupler is essentially a signal output multiplier. With signals from ECA, it produces multiple roll, pitch, and heading output signals.

The A/A24G-39 has three modes of operation. In the SLAVED mode, the system operates as a gyro stabilized magnetic compass. In the Directional Gyro (DG) mode, the system operates independently of the remote compass and provides a heading reference as a latitude corrected directional gyroscope. In the compass (COMP) mode, the system operates as an undamped magnetic compass, slaved to the magnetic azimuth detector.

The A/A24G-39 provides analog (synchro) signal information of the aircraft's attitude (pitch and roll) and heading.

A/A24G-39 OFF/FAST ERECT PANEL

The A/A24G-39 OFF and FAST ERECT switches, marked PORT GYRO and NORMAL/FAST ERECT are located on the instrument panel at the lower left corner of the fuel management panel. The PORT GYRO switch, marked ON/OFF, enables the pilot to control power to the A/A24G-39 displacement gyro after the power passes the AC GYRO COMPASS circuit breaker on the copilot's overhead circuit breaker panel. The OFF position of the PORT GYRO switch secures power to the displacement gyro but does not interfere with power to the compass control system. The FAST ERECT switch, with marked positions NORMAL/FAST ERECT, is spring-loaded to the NORMAL position. Holding the switch in the FAST ERECT position enables the pilot to select a fast erect cycle for the A/A24G-39 displacement gyro. When FAST ERECT is selected, an increased erection voltage is applied to the displacement gyro. If the A/A24G-39 gyro is in a partially erect state, the FAST ERECT switch may be used to maintain the gyro in the fast erect mode until it is completely erected. If the gyro is not completely erected, the gyro warning flag on the copilot's attitude indicator will remain in view and the PORT GYRO caution/light will remain on. The switch should be held to FAST ERECT for a maximum of 30 seconds and then released. Check that the GYRO flag disappears. If the GYRO flag still shows, repeat the use of the FAST ERECT switch until the gyro is erect and the GYRO flag disappears. The use of the FAST ERECT switch is required only when reenergizing the system during coast down.

COMPASS CONTROL PANEL (A/A24G-39) (Figure 4-2)

The control panel, marked COMP on the pilot's console, provides the pilot with system operating controls.

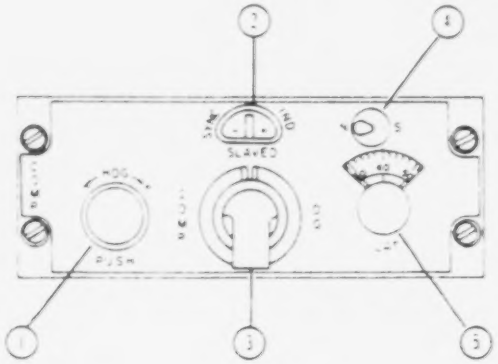


Figure 4-2.

CAUTION

Landing sites with abnormally strong magnetic fields may affect helicopter compass synchronization. Extended time at these areas can cause the remote compass transmitter to slew off heading. The use of the DG mode during operations in the vicinity of these magnetic fields will provide proper heading information after initial departure from the site.

NOTE

If the COMP position is used, disengage the yaw channel of the AFCS.

CONTROL/INDICATOR	FUNCTION
1. Heading Set Control (Knob) (HDG/PUSH)	In the SLAVED mode of operation, depressing and holding this knob automatically causes synchronization of heading outputs to the aircraft compass transmitter heading and sets heading on the Remote Heading Indicator(s). In the DG mode of operation, this knob may be pushed and turned either clockwise or counterclockwise to generate a rate control signal which drives the heading output synchros in either desired direction to a selected heading. In either SLAVED or DG modes, when pushed, the knob also activiates the auto-pilot interlock.
2. Synchronization Indicator (SYNC IND)	The SYNC IND displays the status of the SR3 System heading system. In the SLAVED and COMP modes, the pointer indicates the degree of synchronization between SR3 System heading and the compass transmitter heading. In DG mode the pointer remains fixed in the center position.
3. Mode Selector Switch (COMP-SLAVED-DG)	Use for setting mode of operation. In the COMP mode the SR3 System provides magnetic heading only and also activates auto-pilot interlock. In the SLAVED mode the Displacement Gyroscope heading information is automatically corrected to agree with the compass transmitter heading. In the DG mode the SR3 System provides free gyroscope heading information. Correction for apparent drift resulting from the rotation of the earth is applied in both DG and SLAVED modes.
4. Hemisphere Selector Switch N/S)	Use for setting the polarity of the correction signal for apparent drift due to earth's rotation. This is determined by the hemisphere of operation (Northern or Southern).
5. Latitude Control (LAT)	Use for setting latitude of operation (0 to 90°) to establish the proper correction for apparent gyroscope drift caused by earth's rotation.

Figure 4-3.

CAUTION-ADVISORY PANEL

The caution-advisory panel is located in the right center of the instrument panel. The caution section of the panel provides visual indication of certain failures or unsafe conditions through illumination of amber lights. The advisory section provides visual indication of certain noncritical conditions through illumination of green lights. Each light has its own operating circuit and will remain illuminated as long as the condition which caused the light to illuminate prevails. The caution and advisory lights are powered by the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked PWR under the heading CAUTION PANEL. A switch, marked DIM and BRT, located on the caution panel, enables selection of a dim or bright brilliance of the caution and advisory lights. The switch cannot be used until the rheostat, marked PILOT, FLT INST, located on the overhead switch panel, has been turned on.

MASTER CAUTION LIGHT

Two master caution lights, marked MASTER CAUTION, located on the instrument panel hood, one in front of each pilot, illuminate whenever a caution light on the caution-advisory panel illuminates. The purpose of these lights is to alert the pilots and direct attention to the caution-advisory panel. The lights are press-to-reset type. After the specific condition or malfunction has been noticed on the caution panel, the master lights should be reset to provide a similar indication if a second condition or malfunction occurs while the first is still present.

CAUTION-ADVISORY LIGHT TEST SWITCH

The caution-advisory lights test switch, marked TEST, located on the caution panel, provides a means of simultaneously checking all lights by a single pushbutton switch. The switch receives power from the 28-volt DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked TEST under the heading CAUTION PANEL.

LANDING GEAR SYSTEM

The tricycle landing gear system consists of two retractable main landing gear assemblies, a partially retractable nose gear assembly, and an actuating system. The landing gear hydraulic system operates on 3,000 psi hydraulic pressure from the utility hydraulic system. The necessary electrical power is provided from the DC primary bus, through circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked EMER DN, NOSE, MAIN, and WARN under the general heading LAND GEAR. The main landing gear system is equipped with a one-shot pneumatic, alternate extension system, and the APU accumulator is used as an alternate extension power source for the nose gear assembly. The nose gear assembly retraction system can be used on the ground to kneel the helicopter to facilitate cargo handling. The landing gear control panel is located on the instrument panel.

MAIN LANDING GEAR

The two main landing gear assemblies are located below the sponsons and retract forward and upward into the sponsons. Each main landing gear is equipped with dual wheels and hydraulic brakes, a retracting cylinder, a pneudraulic strut, attaching drag links and supports, up-and down-lock mechanisms, and emergency release mechanisms.

NOSE LANDING GEAR

The single nose landing gear, mounted vertically at the centerline of the helicopter, is free to rotate 360 degrees about the strut centerline. All shock stroke, kneeling, jacking and retraction motion is vertical. The nose gear assembly is equipped with dual wheels, a retracting cylinder, a pneudraulic strut and shimmy damper, and attaching drag links and supports. The entire pneudraulic strut acts as a piston, which is lowered or raised for retracting, jacking, and kneeling. The nose gear may be retracted (kneeled) to alter the ground clearance (figure 4-4) of the tail section to facilitate cargo handling. The nose gear assembly is hydraulically locked in the extended, retracted, or kneeled positions. A centering cam centers the nose gear assembly when the helicopter is airborne. A nose wheel lock is installed to improve ground stability of the helicopter on uneven terrain.

Nose Wheel Lock Handle

The nose wheel lock handle, marked PARK LOCK, is located on the pilot's side of the center console. The nose wheel is locked by pulling the lock handle aft and up, and unlocked by pulling aft and pushing down.

LANDING GEAR ACTUATING SYSTEM

The landing gear actuating system operates on 3,000 psi hydraulic pressure, supplied by the utility hydraulic system to raise or lower the main and nose landing gear assemblies. Each main landing gear is equipped with down-lock release limit switches

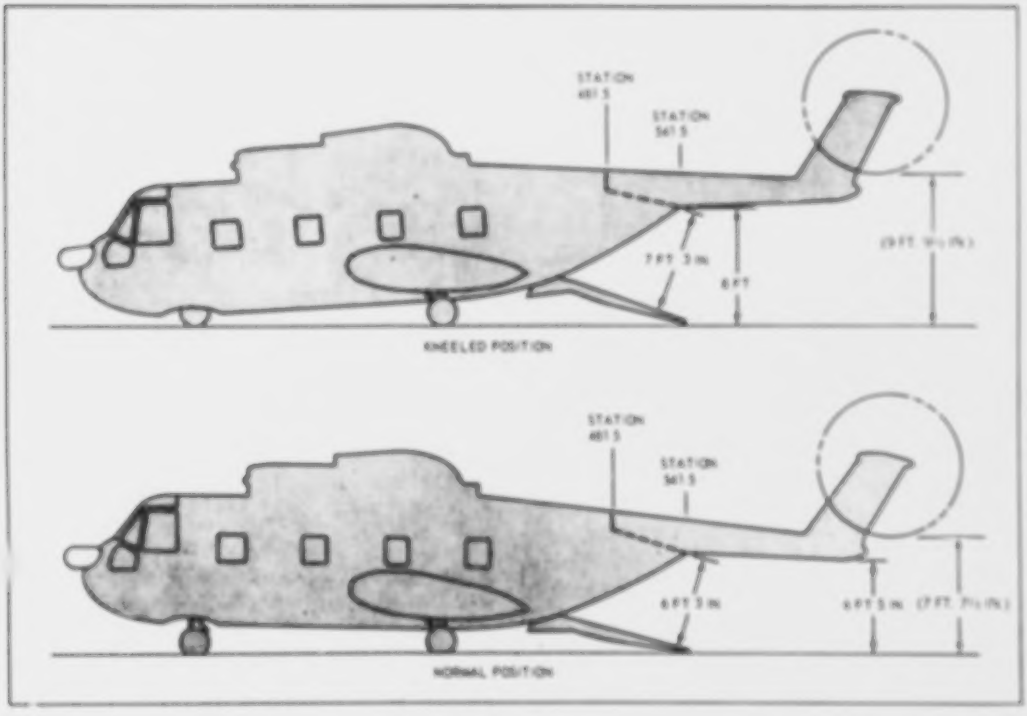


Figure 4-4. - Ground clearances (normal and kneeled).

which prevent inadvertent retracting of the landing gear when the weight of the helicopter compresses the oleo struts. When airborne, the struts extend and close the contacts of the down-lock release limit switches.

The landing gear control panel (figure 4-5) is located on the instrument panel. Placing the landing gear control handle in the UP position retracts the landing gear. As the landing gear retracts, limit switches are actuated that cause the landing gear warning light to go out, and a circuit to be completed that assures electrical power to lower the gear. When the landing gear is fully retracted, limit switches are actuated that cause the landing gear warning light in the handle to go out. The main gears are held up by mechanical uplocks. The retraction cycle of the nose gear system remains energized to maintain the nose gear in the retracted position. The landing gear is extended by placing the landing gear lever in the DN position. This completes the electrical circuit to the solenoid valve that directs fluid to the uplock cylinders of the main landing gears, unlocks them from the up position, simultaneously directs fluid to the actuator, energizes the landing gear control handle warning light, and causes the landing gear to extend. Mechanical spring-loaded locks are engaged to lock the main gear in the down position. As the main landing gear extension phase is initiated, the retraction port of the actuator is vented to relieve pressure that had been holding the nose gear in the retracted position, and hydraulic pressure is directed to the extension port of the actuator to lower the nose gear. Hydraulic pressure is retained in the actuating cylinder to lock the nose gear down. When all gears are fully extended, limit switches are actuated that energize the landing gear position lights and extinguish the control handle warning lights.

Figure 4-5. - Landing gear control panel.

Landing Gear Control Handle Down-Lock Release

A manually operated down-lock release, marked DN LCK REL, is located on the landing gear control panel. The release provides a mechanical override of the landing gear control handle down-lock solenoid if electrical power to the solenoid is interrupted. Should the down-lock solenoid become inoperative, the down-lock release can be actuated to mechanically release the landing gear control handle from the DN position.

Nose Gear Switch and Caution Light

The nose gear switch, marked NOSE GEAR, NORMAL, KNEEL, is located on the overhead switch panel. Kneeling is accomplished by placing the switch in the KNEEL position. Placing the switch in the NORMAL position extends (jacks) the nose gear to the normal down position. An advisory light, marked KNEEL SW, located on the caution-advisory panel, will illuminate when the kneel switch is in the KNEEL position. The green nose gear position light will be out and the red warning light in the landing gear handle will be on when the nose gear is kneeled.

LANDING GEAR ALTERNATE EXTENSION SYSTEM

An alternate gear handle, located on the left side of the center console, is used to lower the landing gear in the event of an electrical or hydraulic failure. The handle mechanically unlocks the main landing gear uplocks, positions a directional valve, and discharges a 3,000 psi air bottle. The compressed air charge actuates valves that vent the return side of the actuators to the reservoir, and then pressurizes the actuators to lower and lock the main landing gear. Simultaneously, fluid from the APU accumulator is directed through an electrically actuated valve to the top side of the nose gear actuating cylinder to lower the nose gear. After an actuation, the valves must be manually reset before the main landing gear air cylinder can be recharged and the landing gear retracted. If the air charge in the cylinder is depleted when the alternate landing gear handle is actuated, main landing gear hydraulic pressure is vented back to the utility reservoir, the uplocks are disengaged, and the main landing gear will lower by its own weight. The mechanical down-locks may not engage.

Landing Gear Pins

When the landing gear pins are inserted into the main landing gear drag link assembly, they provide an additional mechanical down-lock.

BRAKE SYSTEM

The main landing gear wheels are each equipped with hydraulic brakes. The self-contained brake system is operated by toe pedals located on the pilot's and copilot's tail rotor pedals. A parking brake system is also provided. The parking brake handle, marked PARKING BRAKE, is located on the right side of the center console. The parking brakes are applied by depressing the brake pedals, manually pulling the parking brake handle to the PARK position, and then releasing the brake pedals. Depressing the brake pedals will release the parking brakes, allowing the parking brake handle to return to the OFF position.

NOTE

The parking brake handle can be raised and locked in the extended position, thereby illuminating the advisory light, without pressurizing the wheel brake system.

RAMP SYSTEM

The ramp system is divided into two sections, the forward ramp which is horizontal with the cabin floor, in the closed position, and the aft ramp which conforms to the contour of the fuselage, in the closed position. The aft ramp is hinged to the forward ramp and opens outward and downward. The clearance between the ramp, in the open position, and the fuselage structure may be increased by KNEELING the helicopter. The ramp surface has transverse nonskid material installed for personnel footing and for loading vehicular cargo. Fittings rated at 2,500 pounds are installed to secure light cargo carried on the forward ramp. There are no cargo tiedown fittings on the aft ramp floor. Two tiedown fittings rated at 5,000 pounds each are used to suspend the ramp.

The ramp system is electrically controlled and hydraulically actuated by hydraulic pressure from the utility hydraulic system. The auxiliary power unit is the normal source of power for operation of the ramp. The ramp may be lowered manually when hydraulic or electrical power is not available. The aft ramp may be opened in the air, on the ground, or on the water. The forward ramp can be opened beyond the horizontal position only when the weight of the helicopter is on the helicopter's wheels and the aft

ramp is unlocked. The ramp system controls consist of a pilot's ramp control panel, a crewmember's ramp control panel, and a manual uplock release. When actuated, electrical switches on the ramp control panels energize hydraulic solenoid valves which direct hydraulic pressure to the top or down side of the ramp actuating cylinders.

CAUTION

Personnel should refrain from standing on the aft ramp unless it is resting on a surface or supported by the cables, to avoid possible damage to the ramp hydraulic system.

AFT RAMP

An aft ramp, approximately 8 feet in length, at the aft end of the cargo compartment, is used for the loading and unloading of cargo and personnel. The aft ramp is locked in the closed position by two uplock cylinders. The uplock cylinders are mechanically latched and hydraulically released. Two safety cables are to be attached to the aft ramp before and during flight, whether the aft ramp is open or closed. The cables are attached to the fuselage structure and are stowed above the aft ramp. Before and during flight, the cables shall be attached to the ramp. A caution light, marked RAMP, on the caution-advisory panel will illuminate when the aft ramp is not up or not locked. The light receives electrical power from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked RAMP WARN under the general heading INDICATOR LTS.

FORWARD RAMP

The forward ramp, approximately 5 feet 8 inches in length, may be lowered with the aft ramp, making an inclinded entrance to the cabin. The forward ramp contains tiedown fittings for cargo tiedown, troop seats, skid strips, and a nonskid material surface for traction. The forward ramp is normally lowered after the aft ramp is lowered, and raised before the aft ramp is raised. The forward ramp is locked in the closed position by mechanically latched uplocks incorporated in the forward ramp actuating cylinders. The forward ramp is released by hydraulic pressure.

PILOT'S AND CREWMEMBER'S RAMP CONTROL PANELS

A pilot's RAMP CONTROL panel (figure 4-6) is located on the center console. The crewmember's ramp control panel is located on the right-hand cabin side panel above the ramp. The control is

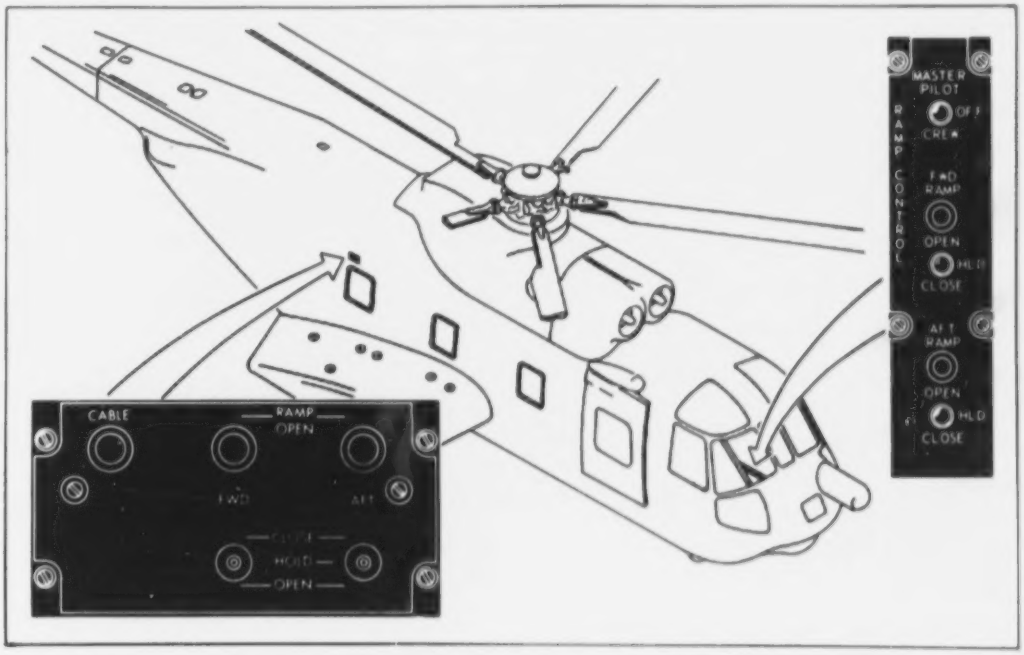


Figure 4-6. - Ramp control panels.

marked RAMP CONT. Both ramp control panels consist of a forward ramp switch, aft ramp switch, forward and aft RAMP OPEN caution lights. An inoperative CABLE caution light is on the crewmember's ramp control panel. The aft ramp switch, marked AFT with marked positions CLOSE, HOLD, and OPEN, controls operation of the aft ramp. The RAMP OPEN caution light, marked AFT, will illuminate when the aft ramp is not up and locked. The forward ramp switch, marked FWD with marked positions CLOSE, HOLD, and OPEN, controls the operation of the forward ramp. The RAMP OPEN caution light, marked FWD, will illuminate when the forward ramp is not up and locked. Extra long cargo may be extended over the aft ramp door with the aft ramp open (horizontal) in flight, but should be loaded in such a way that cargo does not come in contact with the aft ramp. Due to interlocks in the forward ramp control circuit, the forward ramp cannot be opened until the aft ramp is unlocked and the weight of the helicopter is on the helicopter's wheels. The caution lights on both ramp control panels are powered by the DC primary bus and are protected by the same circuit breaker on the overhead circuit breaker panel that protects the RAMP caution light on the caution-advisory panel.

AFT RAMP UPLOCK RELEASE LEVERS

There are two aft ramp manual uplock release levers (figure 4-7). One lever is located on the right side of the cabin above the ramp. The other, the handle type, is located externally under the right-hand side of the tail pylon, aft of the ramp, in an oblong metal container with a hinged cover marked alongside RAMP RELEASE HANDLE PULL. Both controls are connected by a cable to provide a mechanical release of the aft ramp uplocks when electrical or hydraulic power is not available. When the release levers are actuated, the uplocks are released and the ramp will lower under its own weight. Snubbing action, during the ramp opening is provided by a restrictor in the ramp actuating system hydraulic lines. (See figure 4-7.)

FORWARD RAMP UPLOCK RELEASE LEVERS

A manual release lever for the forward ramp actuating cylinder uplocks is installed on the top side of each actuating cylinder. The manual releases provide the means of unlocking the forward ramp when electrical or hydraulic power is not available. The ramp will then lower under its own weight. The rate of ramp lowering is controlled by a restrictor.

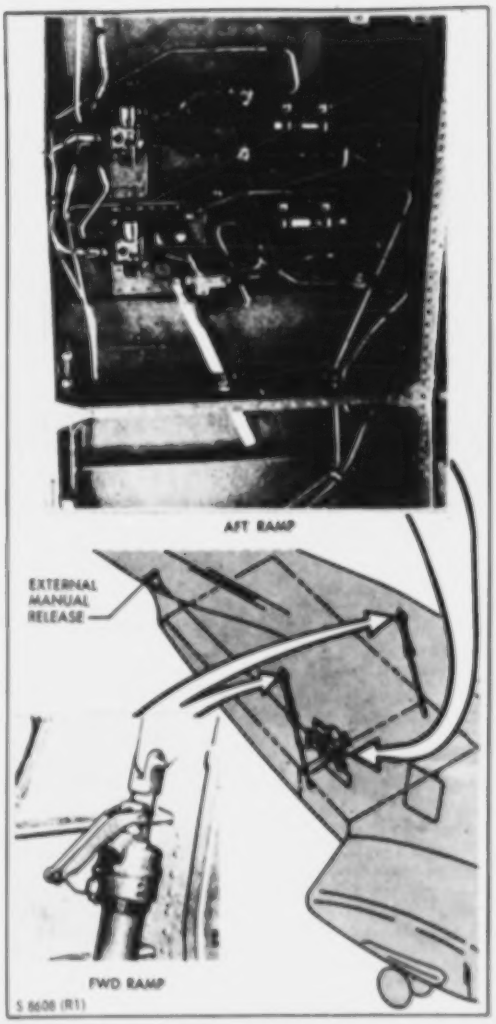


Figure 4-7. - Ramp uplock release levers.

CARGO DOOR

A door is installed in the forward section of the cabin on the right-hand side of the fuselage. The door, approximately 5.5 feet high and 4 feet wide, rides on tracks mounted above and below the door on the outside of the fuselage. A positive acting latch is installed in the door to prevent inadvertent opening in flight. The latch allows the door to be held open in three different positions. The door may be opened from inside the cabin or from the outside by turning the latch handle and sliding the door aft. A removable personnel ladder is installed in the sill of the door to permit entry of personnel. A light, marked CARGO DOOR, on the caution-advisory light panel will illuminate any time the door is not closed and latched.

SELF QUIZ # 4

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When the main rotor blade pitch is increased, tail rotor blade pitch is automatically increased by the action of the _____.

   A. negative force gradient spring
   B. primary servocylinders
   C. stick trim system
   D. mixing unit

2. The cyclic control stick trim system holds the stick in a selected trim position by the use of _____.

   A. electrical power
   B. hydraulic pressure
   C. mechanical linkage
   D. friction blocks

3. Sudden movements of the tail rotor control pedals are prevented by _____.

   A. a pedal damper in the auxiliary servocylinder
   B. mechanical stops at the extreme ends of pedal travel
   C. a restrictor assembly in the control rigging
   D. a counterweight assembly on the tail rotor blades

4. The capacity of the primary hydraulic system reservoir is approximately _____ gallons(s) of hydraulic fluid.

   A. 0.40
   B. 0.45
   C. 1.45
   D. 1.40

5. What happens if the pressure in the auxiliary hydraulic system drops below 1,000 psi?

   A. The auxiliary hydraulic system is automatically shut off
   B. The primary hydraulic system cannot be shut off
   C. The auxiliary system is pressurized by primary system pressure
   D. The primary system is automatically shut off

6. The yaw trim knob on the automatic flight control system control panel is _____ shaped.

   A. bar
   B. circular
   C. triangular
   D. clover leaf

7. The pitot static tube on the right side of the cockpit canopy furnishes ram air pressure to which of the following?

   1. Pilot's airspeed indicator
   2. Common static system
   3. True airspeed transducer
   4. Copilot's airspeed indicator

   A. 1 and 2 only
   B. 3 and 4 only
   C. 1 and 3 only
   D. 2, 3, and 4

8. The compass control panel is located on the _____.

   A. pilot's console
   B. copilot's console
   C. instrument panel
   D. lower center console

9. The nose wheel can swivel a MAXIMUM of _____ degrees.

   A. 70
   B. 90
   C. 180
   D. 360

10. The light in the landing gear control handle will be illuminated when the gear is _____.

   A. up and locked
   B. down and locked
   C. up and the throttle is retarded
   D. in any intermediate position between full up or down

11. In an emergency, the main landing gear is extended by _____.

A. an electric motor
B. air pressure
C. trapped hydraulic pressure
D. a mechanical jackscrew

12. Which statement concerning ramp operation is TRUE?

A. The forward ramp can be opened in flight
B. The aft ramp can be opened on the water
C. The forward ramp must be unlocked before the aft ramp can be opened
D. The forward ramp can be opened on the water

ANSWERS TO SELF-QUIZ #4

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	D	4-3
2	B	4-2
3	A	4-3
4	B	4-4
5	B	4-4
6	C	4-5
7	C	4-6
8	A	4-7
9	D	4-9
10	D	4-10
11	B	4-11
12	B	4-11

Reading Assignment:
Pages 5-1 through 5-11

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the basic operation and characteristics of the:

1. Heating system.
2. Anti-icing systems.
3. Lighting equipment systems.
4. Auxiliary power unit.

HEATING SYSTEM

The heating system (figure 5-1) consists of a blower, air internal combustion heater, a plenum chamber, an ducts which run along the left and right sides of the cabin and into the cockpit. The heater has a 200,000 BTU output. The heater unit, located overhead in the aft end of the cabin above the aft ramp, operates on fuel pumped from the forward main tank to the heater fuel pump and cycling valve to the heater fuel pump and cycling valve to the heater unit, where it is ignited by an ignitor plug. The ignitor plug operates electrically on current from the DC primary bus, boosted by the heater ignition unit mounted in the heater intake port, located aft of the aft ramp on the bottom of the tail pylon, and then through a heat exchanger surrounding the combustion unit. Heated air is then forced into the plenum chamber and the heater ducts. The blower also supplies air to the heater combustion chamber. The heating system is energized by the DC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CABIN HEAT CONT under the general headings DC PRI.

Fuel consumption of the heater unit, when operating continuously in the HIGH position, is 1.2 gallons (8 pounds) per hour.

HEATER SWITCH

The heating system is operated by a switch on the overhead switch panel. The switch is marked CABIN HEATER and has marked positions LOW, OFF, and HIGH. The heater switch controls the heater fuel pump and cycling valve and the ignition unit. When the switch is in the LOW position, the heater will automatically maintain a temperature of approximately 66° C. in the ducts. When the switch is in the HIGH position, the heater will automatically maintain a temperature of approximately 141° C. in the ducts. An overheat switch will shut off the heater if for any reason the heat in the plenum chamber rises to 177° C. The heater amber caution light, marked HEATER HOT, located on the caution-advisory panel, will illuminate and the heater will automatically shut off if the heater blower should fail, if there is no ignition 45 seconds after the heater has been turned on, if the heater flame goes out after ignition, or if an overheat condition occurs. The caution light will flash momentarily when the heater is turned on.

HEATER BLOWER SWITCH

The heater blower switch is located on the overhead switch panel. The switch is marked CABIN HEATER and has marked positions NORM and VENT. The switch controls a relay connecting power from the No. 2 AC primary bus to the heater blower in the heater air intake duct. The switch and

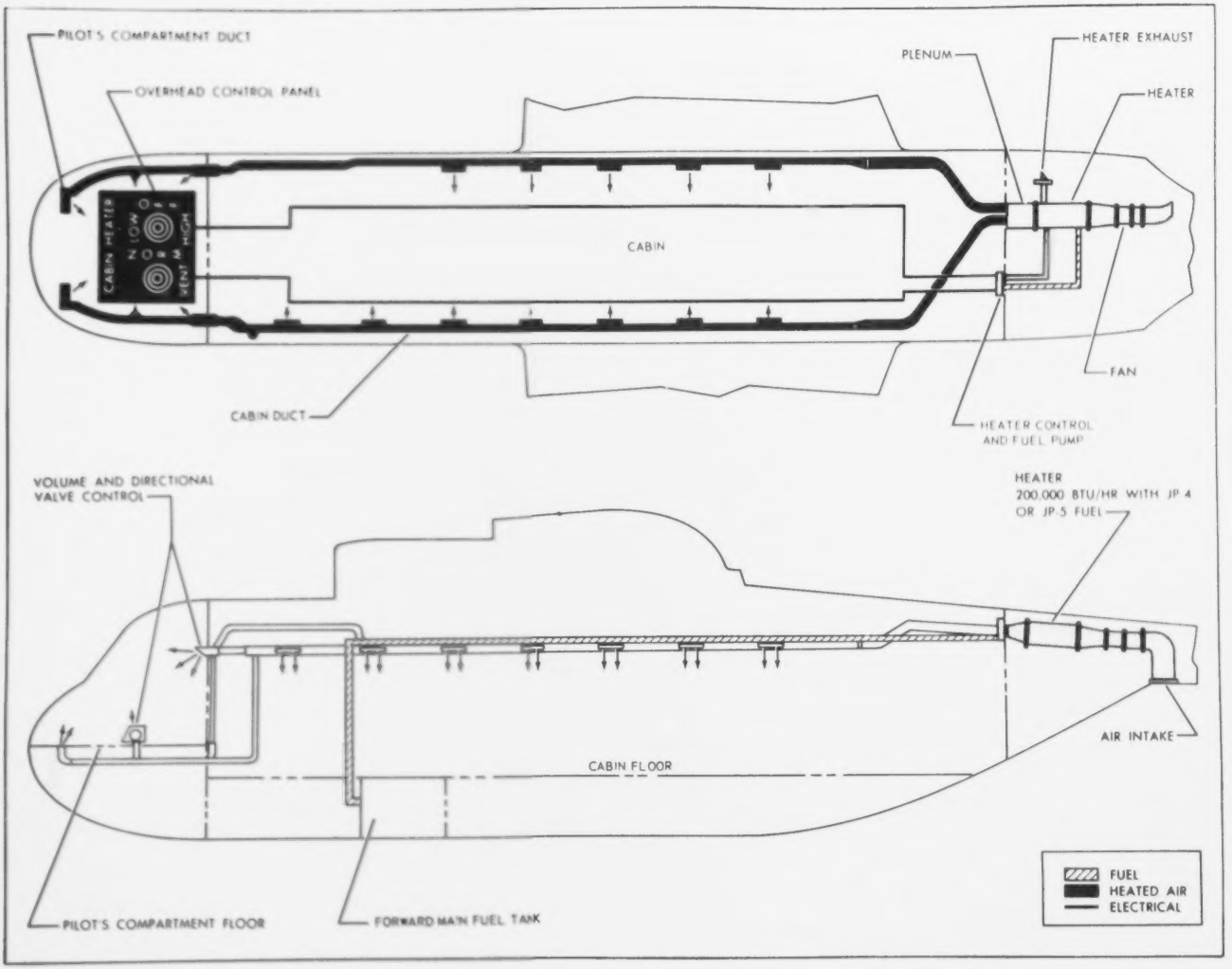


Figure 5-1. - Heating system.

blower control circuit is energized by the DC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CABIN HEAT VENT under the general heading PRI and DC. The blower is protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked CABIN HEATER BLOWER under the general heading No. 2 AC PRI. When the heater switch is in the NORM position, the blower operates in conjunction with the heating system. Placing the heater blower switch in the VENT position will operate the heater blower continuously.

VENTILATING SYSTEM

Placing the heater blower switch in the VENT position, without operating the heater, will draw outside air into the heater system and ventilate the cockpit and cabin.

HEATNG AND VENTILATING DIFFUSERS

Heating and ventiliating diffusers and registers are located in each of the heater ducts that extend along the sides of the cabin and into the cockpit. The cockpit has six diffusers. Two are located above and behind the pilot and copilot, and two are located on each side of the cockpit near the floor. These four diffusers are of the round, adjustable nozzle, air vent type. The open end of the nozzle has a knurled ring which can be turned to control the flow of air from full open to closed. The two remaining diffusers are of the register type and are located on the cockpit floor below the tail rotor pedals. There are twelve diffusers in the cabin, seven in the left-hand duct and five in the right-hand duct. Knobs, marked OPEN, are used to regulate the flow of air through the diffusers. The ducts are stenciled with operation instructions above each diffuser; TURN KNOB FOR VOLUME CONTROL, and PULL CENTER VANE DOWN FOR DIRECTIONAL CONTROL.

ANTI-ICING SYSTEMS

There are four anti-icing systems: (1) engine air inlet anti-icing system, (2) engine inlet guide vane (IGV) anti-icing system, (3) windshield anti-icing system, and (4) pitot head anti-icing system.

ENGINE AIR INLET AND IGV ANTI-ICING SYSTEMS

The engine air inlet and IGV anti-icing systems are designed to prevent ice from forming and subsequently being ingested into the engine. Both systems are operated by the same control switches.

NOTE

If the engine anti-ice advisory light on the caution-advisory panel illuminates during flight when the engine anti-ice switches are in the OFF position this indicates that the engine anti-ice solenoid valve has opened (de-energized) due to electrical failure, and that a loss of approximately 50 horsepower at maximum power, will occur. With complete DC primary bus failure, the solenoid valve will open, but the advisory panel light will not illuminate.

Engine Air Inlet Anti-Icing System

The engine air inlet ducts are anti-iced by thermal electrical resistance elements embedded in the epoxy glass intake ducts. The oil tank mounting ring is anti-iced by a thermal electric boot that is interconnected with the inlet duct heating elements. Electrical current is applied to the heating elements to raise the temperature of the affected areas higher than the temperature at which ice will form. The electrical heating elements for the No. 1 engine air inlet duct and oil tank mounting ring receive operating power from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked NO 1 ENG INLET ANTI-ICE under the general heading NO 1 AC PRI. Operating power for the No. 2 engine air inlet duct and oil tank mounting comes from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked NO 2 ENG INLET ANTI-ICE under the general heading NO 2 AC PRI.

Engine IGV Anti-Icing System

The engine starter fairing, the inlet guide vanes, and the top (12 o'clock), right (3 o'clock), and left (9 o'clock) struts of the front frames of each engine are anti-iced by diverting engine tenth-stage compressor air to heat them. The bottom (6 o'clock) strut is continuously heated by scavenge oil from the No. 1 bearing area. Actuating the engine anti-ice switches deenergizes the engine mounted solenoid valve to the open position, allowing hot compressor air to flow through the front frame of the engines to the inside of the starter fairing and the inlet guide vanes.

WINDSHIELD ANTI-ICING SYSTEM

The pilot's and copilot's windshields are anti-iced by electric current which passes through a transparent electrically resistant film on the inner surface of the outer pane of the windshield. The windshield

anti-icing system consists of a special windshield, a windshield anti-ice controller, transformers, and a switch located on the overhead switch panel. The windshield anti-icing system also de-fogs the windshield.

The copilot's windshield anti-icing system operates from the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked WSHLD ANTIICE COPILOT under the general heading NO 1 AC PRI. The pilot's windshield anti-icing system operates from the No 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked WSHLD ANTI-ICE PILOT under the general heading NO 2 AC PRI. The control circuits use both AC and DC power. The AC control circuit uses ØA from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked WSHLD under the general headings ANTI-ICE and NO 2 AC PRI. The DC control circuit operates from the DC primary bus and is protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked WSHLD ANTI-ICE under the general heading ICE PROTECTION and DC PRI BUS.

PITOT HEATERS

A pitot heater switch, marked PITOT HEAT with marked positions ON and OFF, is located on the overhead switch panel. When the switch is placed in the ON position, an electric heater in each pitot head is turned on to prevent ice formation in the pitot head. The pitot heaters operate from the primary DC bus and are protected by two circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked PITOT HEAT 1 and 2 under the general headings ICE PROTECTION and DC PRI BUS.

LIGHTING EQUIPMENT

INTERIOR LIGHTS

Pilot's and Copilot's Flight Instrument Panel Lights

The pilot's and copilot's flight instrument panel lights and VOR-TACAN selector lights are individually controlled by rheostats are marked PILOT FLT INST and COPILOT FLT INST. With the PILOT FLT INST or COPILOT FLT INST rheostats in the OFF position, the VOR-TACAN lights will operate with a bright, fixed intensity. The VOR-TACAN switch turns the appropriate VOR or TACAN light on. The intensity of the flight instrument lights may be varied by rotating each rheostat.

The copilot's flight instrument lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked CO-PLT FLT INST under the general headings CKPT LTS and NO 1 AC PRI. The pilot's flight instrument lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked PILOT FLT INST under the general headings CKPT LTS and NO 2 AC PRI.

Non-Flight Instrument Lights

The non-flight instrument panel lights are controlled by a rheostat, marked NON-FLT INST, on the overhead switch panel. The intensity of the engine and transmission instrument lights, the hydraulic pressure gage lights, the fuel management backlighting, and fuel quantity lights may be varied by rotating the rheostat. The non-flight instrument lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked NON-FLT INST under the general heading CKPT LTS and NO 1 AC PRI.

Console and Overhead Panel Lights

The white lights on the center console, the overhead switch panel, the pilot's side console, the copilot's side console, and the MARKER BEACON/RAWS control panel are controlled by rheostats on the overhead switch panel. The rheostats are under the heading CONSOLES LOWER and OVHD. An additional rheostat for red lighting on the lower center console, pilot's side console, and copilot's side console is on the overhead switch panel under the headings LOWER CONSOLE RED LIGHTS. The center console lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked CSL LOWER under the general headings CKPT LTS and NO 2 AC PRI. The cockpit overhead panel lights operate from the No. 1 AC primary bus and are protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked CSL OVHD under the general headings CKPT LTS and NO 1 AC PRI.

Cockpit Dome Lights and Secondary Instrument Light

There is one red and one white dome light on the cockpit overhead dome light panel. These lights are

controlled by a guarded switch on the dome light panel. The switch is marked DOME LIGHTS - CKPT with the marked positions RED, OFF and WHT. This switch will supply white light of a fixed intensity. In addition, the red dome light may be used as a secondary instrument light. When the red dome light is used as an instrument light, it should be turned on and its intensity adjusted with the rheostat, marked SECONDARY INST, on the overhead switch panel. These lights are powered by the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked COCKPIT DOME under the general headings INT LTS and DC PRI BUS.

Cockpit Utility Lights

Two portable utility lights with coiled cords are secured, one on each outboard side of the cockpit above the sliding windows. The lights may be adjusted on their mountings to direct the light beams, or they may be removed and used as portable lights. The utility lights are each controlled by a rheostat or a pushbutton, located on the end of each light casing. The lens casing of the light may be rotated to position a red filter converting the white light to a red light. The cockpit utility lights operate from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked COCKPIT DOME under the general headings INT LTS and DC PRI BUS.

Scroll Check List Light

The scroll checklist light is controlled by an on-off rheostat switch mounted on the left side of the checklist container. The scroll checklist light operates from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CHECK LIST under the general headings INT LTS and DC PRI BUS.

Avionicsman's Panel Light Control

The avionicsman's panel light control rheostat, marked PNL LTS, is located on the radio rack in front of the avionicsman's table and controls light intensity of the Navigator's clock. The night lighting for the HF head, INTER ICS panel, and RADIO panel is controlled by the LOWER CONSOLE RED LIGHTS rheostat on the overhead switch panel in the cockpit. The avionicsman's panel lights operate from the No. 2 AC primary bus and are protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is marked NAV under the general headings CREW LTS and NO 2 AC PRI.

Avionicsman's Utility Light

A portable utility light, with coiled cord and mounting base, is secured to the left side of the cabin beside the avionicsman's table. The light is controlled by a rheostat on the mounting base. The light may be adjusted on its mounting base to direct the light beam, or it may be removed and used as a portable light. The utility light can be adjusted to operate as a red or white light. The avionicsman's utility light operates from the No. 2 AC primary bus and is protected by a circuit breaker on the pilot's overhead circuit breaker panel. The circuit breaker is marked MAP LT under the general heading NO 2 AC PRI.

Cabin Dome Lights

The four cabin dome lights (9, figure 5-2) are controlled by a guarded switch on the cockpit dome light panel. The switch is marked CABIN under the general heading DOME LIGHTS, with marked positions RED, OFF, and WHT. The cargo compartment dome lights are equipped with a red and a white lamp. The red or white light may be turned on at any time DC power is available at the DC monitor bus. The white light may be turned on only if the guard is lifted. The cabin dome lights operate from the DC monitor bus and are protected by a circuit breaker located on the pilot's circuit breaker panel. The circuit breaker is marked CABIN DOME LTS under the general headings DC MON.

Loading Lights

Two loading lights (10 and 14, figure 5-2), one in the ceiling of the cabin above the ramp and one in the bottom of the tail pylon, provide illumination for the ramp loading area. The lights are controlled by a two-position switch, marked LOADING LTS, ON, OFF, located on the overhead switch panel. The loading lights receive power from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked LOADING under the general headings EXTERIOR LTS and DC PRI BUS.

EXTERIOR LIGHTS

Controllable Searchlight

The forward facing searchlight located in the nose of the helicopter can move on its hinged mounting bracket forward and down through a 120° arc. In addition, the searchlight can rotate 360° in either direction on its axis. However, it is restricted to 45° left or right until the unit has extended forward and down 110° to 120°, at which time the light will rotate 360°. The extend motor, rotate motor, limit switches and lamp are enclosed in

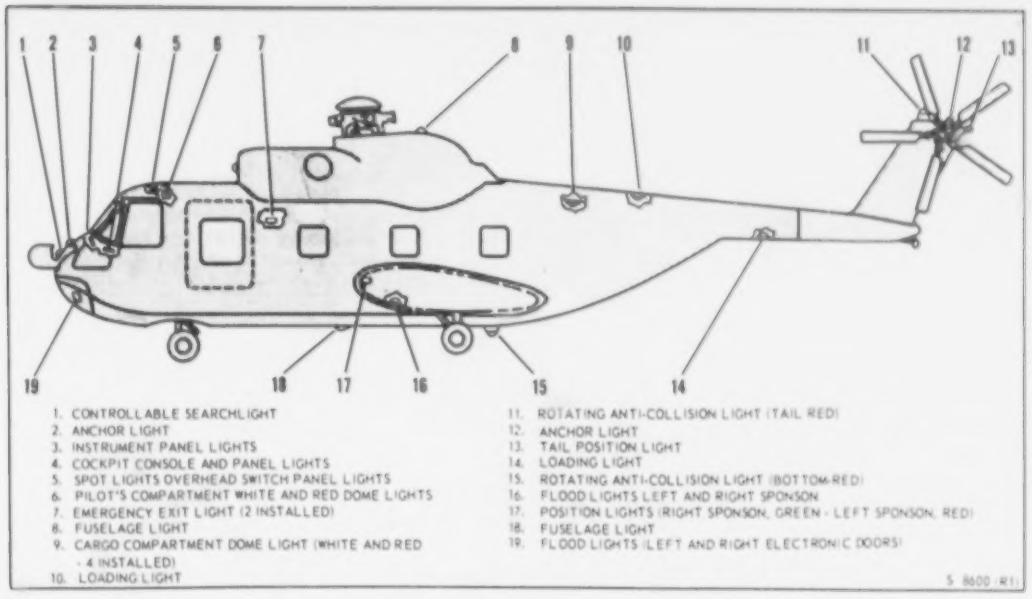

1. CONTROLLABLE SEARCHLIGHT
2. ANCHOR LIGHT
3. INSTRUMENT PANEL LIGHTS
4. COCKPIT CONSOLE AND PANEL LIGHTS
5. SPOT LIGHTS OVERHEAD SWITCH PANEL LIGHTS
6. PILOT'S COMPARTMENT WHITE AND RED DOME LIGHTS
7. EMERGENCY EXIT LIGHT (2 INSTALLED)
8. FUSELAGE LIGHT
9. CARGO COMPARTMENT DOME LIGHT (WHITE AND RED - 4 INSTALLED)
10. LOADING LIGHT
11. ROTATING ANTI-COLLISION LIGHT (TAIL RED)
12. ANCHOR LIGHT
13. TAIL POSITION LIGHT
14. LOADING LIGHT
15. ROTATING ANTI-COLLISION LIGHT (BOTTOM-RED)
16. FLOOD LIGHTS LEFT AND RIGHT SPONSON
17. POSITION LIGHTS (RIGHT SPONSON, GREEN - LEFT SPONSON, RED)
18. FUSELAGE LIGHT
19. FLOOD LIGHTS (LEFT AND RIGHT ELECTRONIC DOORS)
S-8600 (R1)

Figure 5-2. - Lighting system.

waterproof housings. There are three searchlight position control switches, one located on each collective pitch grip, marked SLT TRAIN, and the third on the copilot's searchlight and ICS switch panel. The illumination switch is on the overhead switch panel. The switch is labeled SEARCH, with marked positions STOW, OFF, and ON, and is under the general heading EXTERIOR LTS. The SLT TRAIN switch is a spring-loaded, four-position, thumb switch, center position OFF, with marked positions, FWD, AFT, L and R. Placing the SEARCH switch in the ON position lights the controllable spotlight and furnishes power to the SLT TRAIN switch to control the searchlight movement. When the SLT TRAIN switch is placed in the FWD position, the controllable searchlight extends by revolving forward and down a maximum of 120° from its stowed position, and it may be stopped at any intermediate position by releasing the switch. Placing the switch in the AFT position retracts the light until the searchlight is in the fully stowed position. When the switch is placed in the L or R position, the searchlight will rotate to the left or right. The searchlight position control switch mounted on the copilot's landing light and ICS switch panel operates in the same manner, and is marked LDG LTS with the marked positions FWD, AFT, L and R. If the SEARCH switch is placed in the STOW position while the controllable searchlight is extended, the searchlight will automatically go out and then retract to the stowed position. The switch is then placed in the OFF position. The controllable searchlight operates from the DC primary bus and is protected by circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked SEARCH LIGHT, PWR, and CONT under the general heading EXTERIOR LTS.

Hover Lights

Four hover lights, one located on each side of the electronics compartment door and one located on the lower leading edge of each sponson, are controlled by a pushbutton switch, marked FLOOD HOVER, on the overhead switch panel. The button portion of the switch is a green lens that illuminates when the switch is pressed to illuminate the hover lights, and goes out when the button is pressed to turn off the hover lights. The hover lights illuminate an area forward and below the helicopter. The hover lights operate from the DC monitor bus and are protected by three circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked CONT, LH, and RH under the general headings FLOOD LTS, and DC MON.

CAUTION

The hover lights should not be left illuminated for more than 15 minutes at a time, to prevent overheating. The length of time while illuminated and the OAT will determine the cooling off period.

Position Lights

The position lights (17, figure 5-2), located on the sponsons and pylon, are controlled by two switches on the overhead switch panel. The switches are marked POSITION under the general heading EXTERIOR LTS. One switch will turn the lights on in a STEADY or FLASH configuration or turn the lights OFF. The other switch, marked DIM and BRT, will adjust the intensity of the lights accordingly when they are in the STEADY or FLASH configuration. The position lights operate from the DC primary bus and are protected by a circuit breaker on the overhead breaker panel. The circuit breaker is marked POS under the general headings EXTERIOR LTS and DC PRI BUS.

Fuselage Lights

Two fuselage lights (8 and 18, figure 5-2) are installed on the helicopter. One light is located on the top rear side of the transmission compartment and the other on the bottom of the hull. Both lights are controlled by a three-position switch on the overhead switch panel. The switch is marked FUSELAGE under the general heading EXTERIOR LTS, with marked positions DIM, OFF, and BRIGHT. The lights receive power from the DC primary bus and are protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked FUS under the general heading EXTERIOR LTS.

Anchor Lights

Two anchor lights (2 and 12, figure 5-2), one located on the nose and the other on the pylon, are controlled by a two-position switch on the overhead switch panel. The switch is marked ANCHOR under the general heading EXTERIOR LTS, with marked positions ON and OFF. The anchor lights receive power from the battery bus and are protected by a circuit breaker, marked ANCHOR LTS. The circuit breaker is on the battery bus circuit breaker panel on the center console.

Rotating Anti-collision Lights

Two rotating anti-collision lights (11 and 15, figure 5-2), one located on the top of the tail pylon and the other on the bottom of the fuselage, are controlled by two switches on the overhead switch panel, under the general headings EXTERIOR LTS and ANTI-COLLISION. The left-hand switch, under the heading FWD with marked positions ON and OFF, controls the forward anti-collision light. The right-hand switch, under the heading AFT with marked positions AFT, ON and OFF controls the aft rotating anti-collision light. The rotating anti-collision lights operate from the DC primary bus and are protected by two circuit breakers on the overhead circuit breaker panel. The circuit breakers are marked FWD and AFT under the general headings ANTI-COLL and EXTERIOR LTS.

AUXILIARY POWER UNIT

The auxiliary power unit (APU) (figure 5-3), located to the rear of the main gear box, enables ground starting of the engines and ground operation of the electrical and hydraulic systems. The APU system consists of a control panel, and accumulator assembly, a hydraulic starter motor, a turbine engine, a fuel system, a self-contained oil system, and a mechanical drive. Starting power for the APU is furnished by means of an accumulator system mounted on the transmission deck. The accumulator carries an initial air charge of 1,600 psi and is hydraulically charged to 3,000 psi by the utility hydraulic pump. In addition, the system has provisions for hand pumping and may be charged in this manner with a hand pump, located on the right side of the cabin interior. When starting circuitry is energized, the start valve is opened, and hydraulic pressure from the accumulator is dumped into the APU starter. As soon as the turbine reaches operating speed and is driving the main gear box accessory section, the utility pump pressure recharges the accumulator with 3,000 psi pressure. The turbine engine has a self-contained oil system.

Electrical power for the control circuit is supplied from the DC primary bus through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CONT under the general headings APU and DC PRI BUS. This control circuit operates the automatic control system and the automatic emergency shutdown operation of the APU. The electrical power may be supplied from the battery or from an external power source. Fuel is supplied from the aft main tank. A fuel pressure switch actuates at approximately 110 psi to supply fuel to the combustion chamber through both the start fuel nozzle and main fuel ejectors and to commence ignition. At 90 percent speed, the start fuel nozzle and ignition are turned off by the speed switch and burning is self-sustaining as long as there is a flow of fuel through the APU main fuel valve. Fuel is consumed at 73 pounds (maximum) per hour. A mechanical drive with an automatic clutch is provided to drive the main gear box accessories section. The automatic clutch contains a freewheel unit that

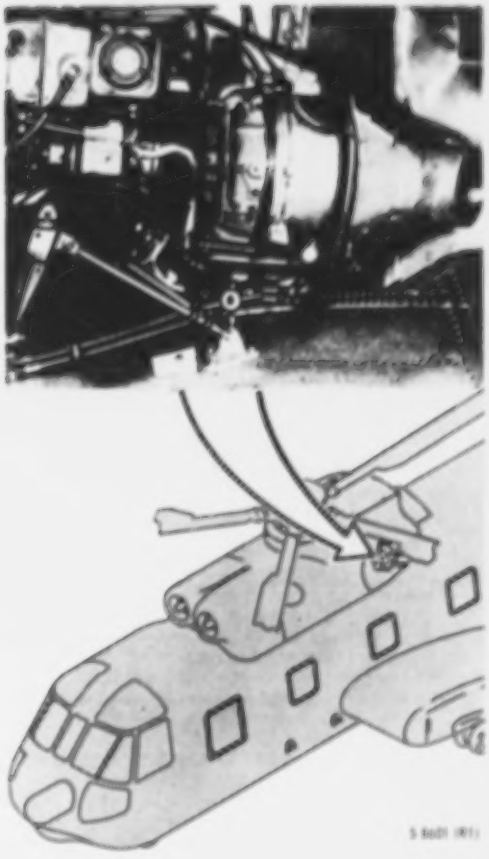


Figure 5-3. - Auxiliary power unit.

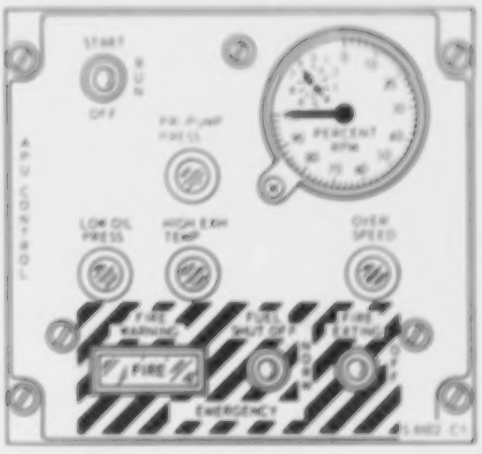


Figure 5-4. - Auxiliary power control panel.

enables shutdown of the APU when the rotor head is engaged. Low oil pressure, high exhaust temperature or overspeed will cause the APU to shut down automatically.

APU CONTROL PANEL

The APU control panel (figure 5-4) located on the pilot's side console contains a master switch, a tachometer, an emergency panel and the following amber caution lights: prime-pump pressure, low oil pressure, high exhaust temperature and overspeed. The emergency panel contains a red fire warning light and fuel shutoff and fire extinguisher switches. During starts, the hydraulic start valve opens to motorize the engine. The prime pump also comes on for 20 seconds, then automatically goes off.

APU Function Switch

The APU master switch, with marked positions START, RUN, and OFF, controls operation of the APU. The switch must be held in the START position as it is spring-loaded to the RUN position. Holding the switch in the START position energizes the components of the automatic starting system and starts the APU. When the switch is released and returns to the RUN position, the APU will run normally and drive the accessory section of the main gear box. The switch is placed in the OFF position to close the main fuel valve and shut down the APU. The APU master switch is energized by the DC primary bus and is protected by a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked CONT under the general headings APU and DC PRI BUS.

APU Tachometer

The tachometer indicates the percentage of APU engine rpm. The tachometer receives power from an APU-driven tachometer generator.

APU Low Oil Pressure Caution Light

An amber low oil pressure caution light, marked LOW OIL PRESS, will illuminate to indicate the APU has been automatically shut down because of low oil pressure.

APU High Exhaust Temperature Caution Light

An amber exhaust temperature caution light, marked HIGH EXH TEMP, will illuminate to indicate the APU has been automatically shut down because of abnormally high exhaust temperatures.

APU Overspeed Caution Light

An amber overspeed caution light, marked OVERSPEED, will illuminate to indicate the APU has been automatically shut down because its speed reached 110% rpm.

APU Prime Pump Press Caution Light

An amber prime fuel pump pressure caution light, marked PRI-PUMP PRESS, will illuminate whenever the prime pump is not delivering enough fuel pressure to open the pressure switch. A prime pump failure would be indicated by the illumination of the PR PUMP caution light for 20 seconds, upon initiating starting procedures.

APU Emergency Fuel Shutoff Switch

The emergency fuel shutoff switch, with marked positions FUEL SHUTOFF and NORM, is used to shut the APU down in an emergency. When the switch is in the NORM position, the APU performs normally and the APU fire extinguisher circuit is de-energized. Placing the switch in the FUEL SHUTOFF position closes the main fuel valve and allows the APU fire extinguisher circuit to be energized. The emergency fuel shutoff switch is energized from the DC primary bus, through the CONT circuit breaker.

APU Fire Extinguisher Switch

The APU fire extinguisher switch, with marked positions FIRE EXTING and OFF, discharges the APU fire extinguishing agent to the APU. The switch receives power from the DC primary bus, through the FUEL SHUTOFF position of the APU emergency fuel shutoff switch, through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked EXT under the general headings FIRE, APU, and DC PRI BUS.

APU Fire Warning Lights

Two red press-to-test APU fire warning lights, marked FIRE WARNING on the APU control panel, the APU FIRE on the caution advisory panel, provides an indication of fire in the APU. The light receives electrical power from the DC primary bus through the APU fire detection system through a circuit breaker on the overhead circuit breaker panel. The circuit breaker is marked DET under the general headings FIRE, APU, and DC PRI BUS.

APU Advisory Light

A green light on the caution-advisory panel, marked APU, comes on whenever the main fuel valve opens (at approximately 30% APU speed) just before lite-off and will stay on until the APU is shut down.

APU HAND PUMP AND ACCUMULATOR GAGE

The hand pump and gage are located in the cabin forward of the last window on the right-hand side. The hand pump (figure 5-5) is used before starting the turbine if the 3,000 psi pressure from the accumulator is not available or is insufficient. At -54° C. a pressure of approximately 4,000 psi is required to start the turbine. A visual indication of pressure can be observed on the hand pump gage during pumping operations.

APU STARTING PROCEDURE

APU START/RUN CHECKLIST

MINIMUM CREW TO RUN APU -
1 FIREGUARD.
1 COCKPIT OPERATOR.

PREFLIGHT

1. SIGHT CHECK APU COMP., INTAKE & EXHAUST.
2. APU WORK PLATFORM - closed.
3. APU ACCESS DOORS - closed.

MINIMUM CREW TO COMPLETE CHECKLIST - TWO.
FIREGUARD MAY READ ALL ITEMS UP TO #33, THEN ASSUME FIREGUARD POSITION.

STARTING CHECKLIST (#1-3 FOR NIGHT ONLY)

1. BATTERY SWITCH - on.
2. COCKPIT LIGHTING CONTROL - 7 rheostats full.
3. PILOTS OVERHEAD MAP LIGHT - on & positioned.

NORMAL DAYTIME PROCEDURES

4. OVERHEAD CIRCUIT BREAKERS - set.
5. ENG ANTI-ICE - off.
6. WINDSHIELD ANTI-ICE - off.
7. SEARCH LIGHT - off.
8. ANCHOR LIGHT - off.
9. FUSELAGE LIGHT - off.
10. ANTI-COLLISION LIGHTS - off (2).
11. POSITION LIGHTS - off.
12. CABIN HEATER - normal & off.
13. PITOT HEAT - off.
14. WINDHSIELD WIPERS - off.
15. WINDSHIELD WASHERS - off.
16. LOADING LIGHTS - off.
17. EMERG LIGHT - arm.
18. NOSE GEAR - normal.
19. HOIST MASTER - off.
20. CARGO HOOK - off.

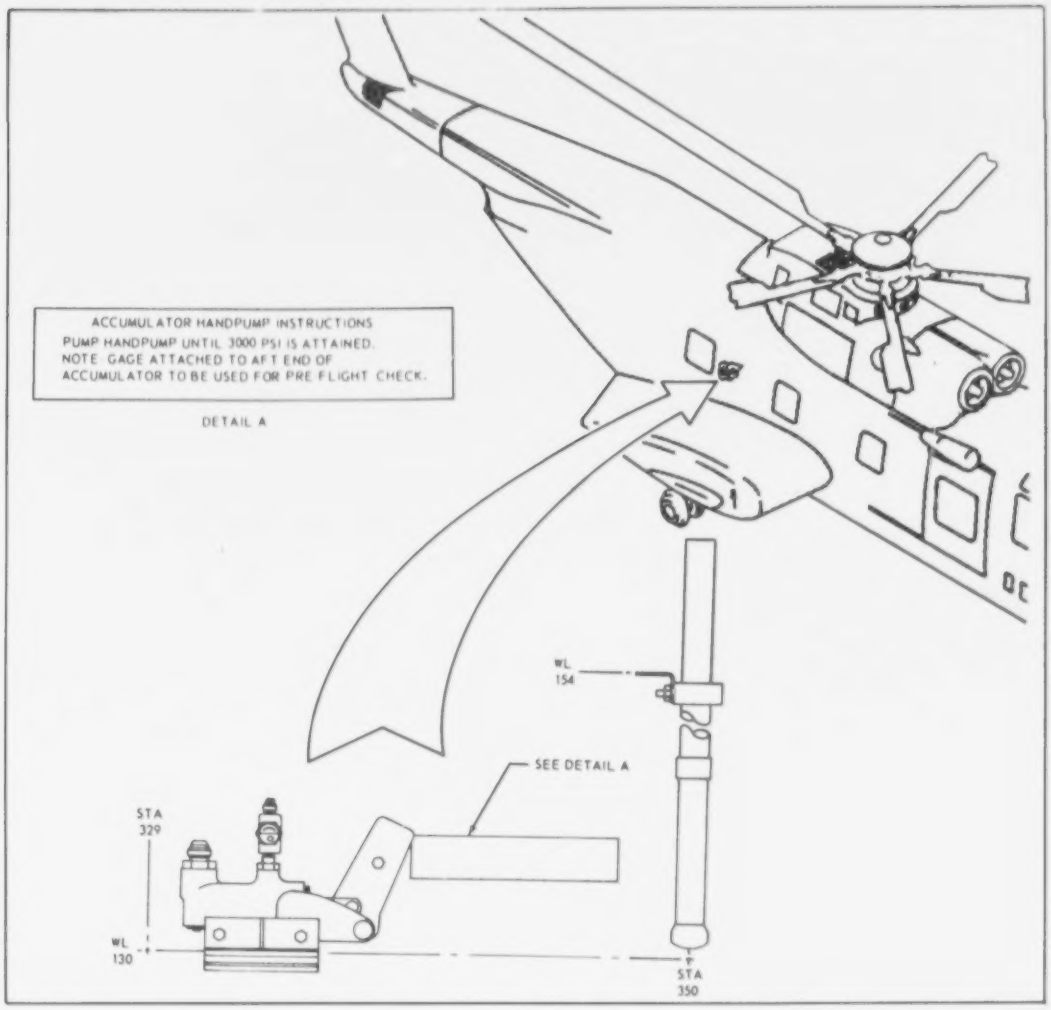


Figure 5-5. - APU accumulator hand pump.

21. STICK TRIM MASTER - on.
22. CHANNEL MONITOR - off.
23. CONVERTERS (2) - on.
24. EXT PWR - off.
25. BATTERY - on.
26. GENERATOR SWITCHES (2) - on.
27. ROTOR BRAKE - on press min 320 psi.
28. GEAR HANDLE - down/green lights.
29. PARKING BRAKE - set.
30. RAMP MASTER - off.
31. APU FUEL SHUTOFF - normal.
32. APU FIRE EXTINGUISHER - off.
33. APU START/RUN SWITCH - run.
    a. CK FOLLOWING LIGHTS ON - high exch temp & overspeed.
    b. PRESS TO TEST - prime pump press/ low oil press.
    c. ENG FIRE WARNING TEST SWITCH TO #2 ENG/APU FIRE LIGHT ONLY
34. FIREGUARD - in position.
35. APU START/RUN SWITCH - start position until Ng passes 45%, then release to run.
36. APU CLUTCH ENGAGEMENT - 76 to 85% Ng.
37. HYDRAULIC PRESS GAGES (3) - press up.

38. WARNING PANEL LIGHTS - tested.

Following lights on warning panel must be out: CONVS 1-2, GENS 1-2, PRI-HYD PRESS AUX-HYD PRESS XMISSN OIL PRESS, & XMISSN CHIP DET.

39. BATTERY - off.

SECURE CHECKLIST

1. BATTERY - on.
2. EMERG LIGHT - disarm.
3. APU START/RUN SWITCH - off.
4. COCKPIT LIGHTING CONTROL - 7 rheostats closed.
5. STICK TRIM MASTER - off.
6. CONVERTERS (2) - off.
7. GENERATORS (2) - off.
8. PILOT'S OVERHEAD MAP LIGHT - off.
9. COCKPIT DOME LIGHT - off.
10. BATTERY SWITCH - off.

APU FIRE FIGHTING PROCEDURES - (obtain positive indication of fire before firing EXTING)

1. APU EMERG FUEL SHUTOFF - shut off.
2. APU FIRE EXTING - fire exting.
3. APU MASTER SWITCH - off.
4. EXIT A/C ASSIST FIGHTING FIRE

APU LIMITATIONS

1. CLUTCH ENGAGEMENT - 4-6 seconds.
2. Ng TOPPING - 99% - plus or minus 1%.
3. MOMENTARY OVERSHOOT - 110% Ng.
4. TOTAL TIME FOR START - approx 10 sec (never exceed 18 sec).
5. ABORT START IF -

   a. No Ng indication
   b. Warning light on APU panel lit
   c. Warning lights cited in #38 lit
   d. APU limitation exceeded

6. APU ADVISORY LIGHT ON WARNING PANEL - on above 30% Ng.

APU EMERGENCY STARTING PROCEDURE

The 3,000-psi pressure from the accumulator has a two time starting capability. However, if the pressure in the accumulator becomes depleted, the manual hydraulic pumping system can be used to replenish pressure in the accumulator.

SELF QUIZ # 3

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. Heater fuel is taken from the _____ fuel tank.

A. forward main
B. forward aux
C. aft main
D. aft aux

2. Which of the following are anti-iced by thermal electric boots?

1. Oil tank mounting ring
2. Engine air intake duct
3. Inlet guide vanes
4. Starter cover

A. 1 and 2 only
B. 2 and 3 only
C. 3 and 4 only
D. 1, 2, and 3

3. The pilot's windshield anti-icing system operates from the _____ bus.

A. DC primary
B. No. 1 AC primary
C. No. 2 AC primary
D. No. 1 AC start

4. The cabin dome light guard is lifted to turn _____.

A. the red light on
B. the white light on
C. both lights on
D. both lights off

5. To prevent overheating, the hover lights are limited to _____ minutes of operation.

A. 5
B. 10
C. 15
D. 20

6. The APU is started by a/an _____.

A. electric motor
B. air turbine starter
C. electric motor
D. hydraulic motor

7. Fuel to operate the APU is taken from the _____ fuel tank.

A. forward main
B. forward aux
C. aft main
D. aft aux

8. The APU start fuel valve is energized until the unit reaches _____ percent of its rated speed.

A. 50
B. 75
C. 90
D. 100

9. The APU will automatically shut down when the speed reaches an rpm of _____ percent.

A. 104
B. 106
C. 108
D. 110

10. The APU START/RUN switch is released to the RUN position from the start position as Ng passes _____ percent.

A. 45
B. 56
C. 76
D. 80

ANSWERS TO SELF-QUIZ #5

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	A	5-1
2	A	5-3
3	C	5-4
4	B	5-5
5	C	5-6
6	D	5-7
7	C	5-7
8	C	5-7
9	D	5-8
10	A	5-10

COMMUNICATION SYSTEMS

Reading Assignment:
Pages 6-1 through 6-19

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. AN/AIC-18 ICS
2. AN/ARC-51A UHF

Since some communication and navigation systems are interrelated, the first part of this section will deal briefly with both systems. The remainder of the section explains the communication system in detail. We will discuss the navigation system in detail in another section.

COMMUNICATION AND NAVIGATION SYSTEMS

Electronic systems permit communication, navigation, and intercommunication between crew members. The systems also provide sensor inputs to the automatic flight control system (AFCS) and the attitude indicating system. The communication and navigation systems installed in the helicopter are listed in figure 6-5 and figure 6-6.

COMPONENT LOCATIONS

(See figures 6-2, 6-3, 6-4.)

Most communications and navigation system components are located in the electronics compartment below the cockpit, on the forward and aft cabin electronic racks, in the Doppler bay, and in the cockpit. Component locations for each system are shown in separate location diagrams contained in this pamphlet. Detail locations for system control panels are shown in figure 6-2, 6-3, 6-4.

COMPONENT REMOVAL/INSTALLATION

WARNING

To prevent injury to personnel and damage to equipment, turn off electrical power before performing any maintenance on electronic or electrical equipment.

Bow Electronics Compartment

Navigation system components secured on their respective mountings are removed either by releasing the nut-locking devices at the front of the mounting and sliding the component out of its mounting and off the shelf, or by disconnecting the particular cable connector, releasing the nut-locking devices at the front of the mounting, and sliding the component out of its mounting and off the shelf. Navigation system components not secured on mountings are removed by removing the attaching screws, bolts, or other securing devices, and lifting the component from the shelf. Install navigation system components by sliding the component into its mounting, ensuring proper mating of component receptacle and mounting plug, and by either tightening the nut-locking devices at the front of the mounting, or by tightening the nut-locking devices at the front of the mounting, and connecting the cable connector. Navigation system components not installed on mountings are secured in their respective places with screws, bolts, or other securing devices. Fasteners and electrical connectors of hard mounted components shall be safety wired.

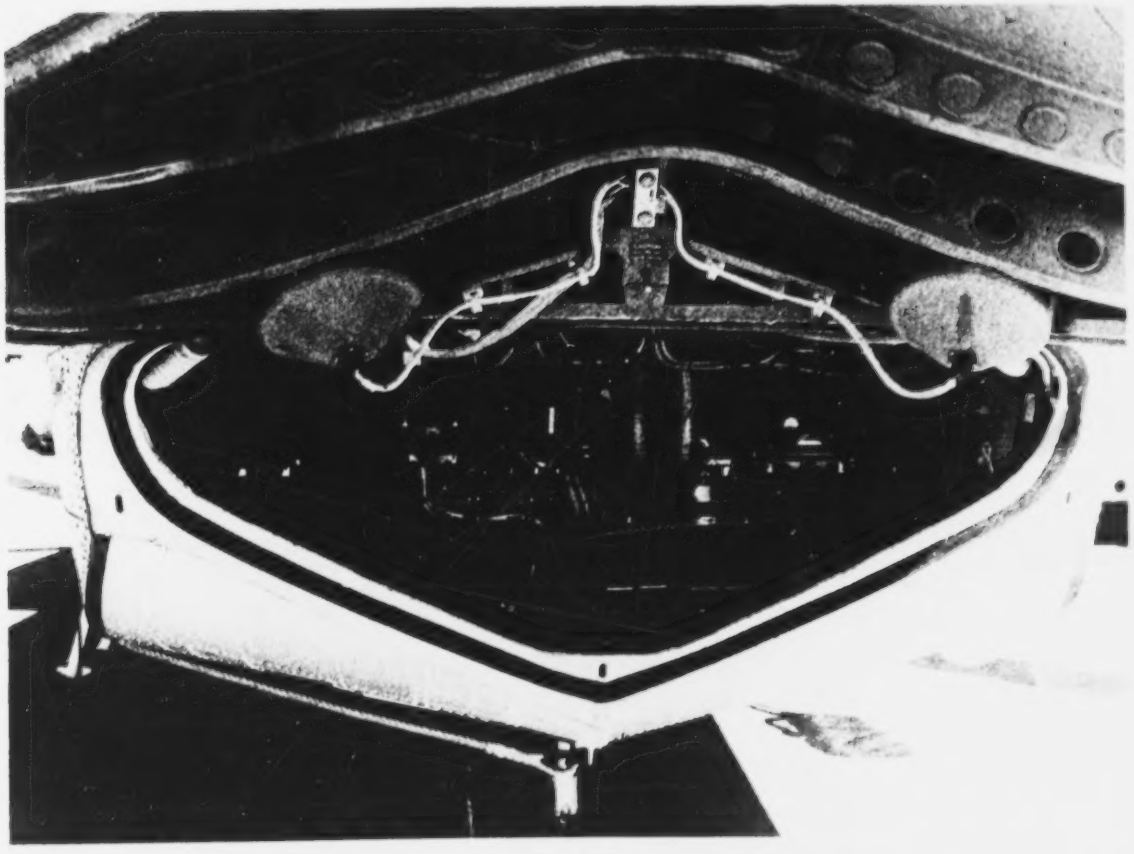


Figure 6-1. - Bow electronics compartment.

Cabin Electronic Mounting Racks

The aft cabin rack has removable side panels for accessibility. The majority of communication system components secured on their respective mountings are removed by disconnecting the appropriate cable connectors, releasing the nut-locking devices at the front of the mounting and sliding the component out of its mounting and off the shelf. Communication system components not secured on mountings are removed by removing the attaching screws, bolts, or other securing devices, and lifting the component from the shelf. Install communication system components by sliding the component into its mounting, ensuring proper mating of component receptacle and mounting plug, and by tightening the nut-locking devices at the mounting, and connecting the cable connector. Communication system components not installed on mountings are secured in their respective places with screws, bolts, or other securing devices. Fasteners and electrical connectors of hard mounted components shall be safety wired.

Instrument Panel

The instrument panel contains the pilot's and copilot's navigation instruments and search radar control unit. A navigation instrument is removed from the instrument panel by loosening the fasteners, carefully lifting the instrument sufficiently from the panel recess to gain access to the rear disconnect plug, and disconnecting the plug.

Consoles

Remove a control panel from a console by loosening the fasteners, lifting the control panel sufficiently from the console recess to gain access to the rear disconnect plug, and disconnecting the plug.

GROUNDING PRACTICES

An adequate ground must be provided for all communication and navigation components.

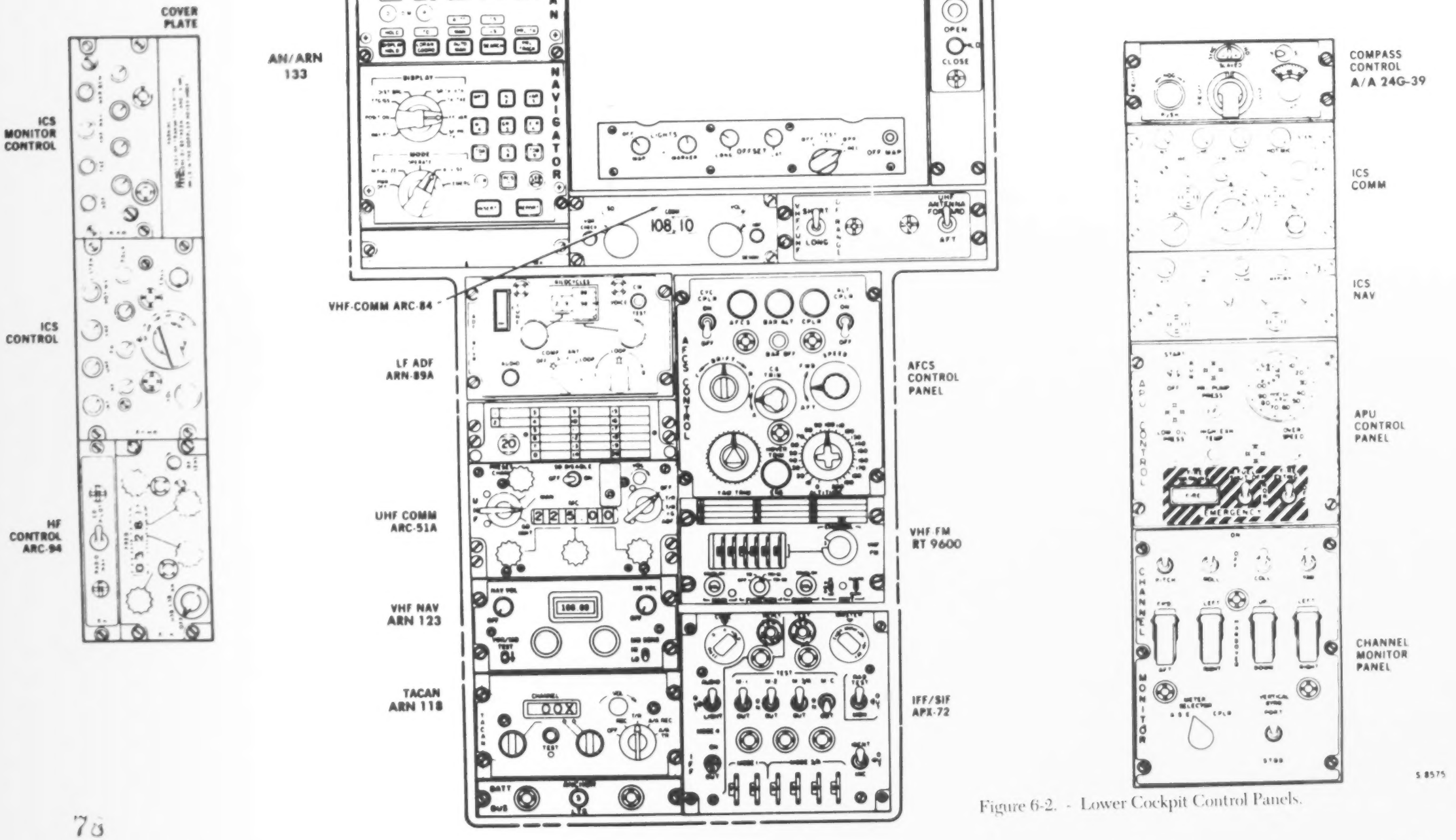
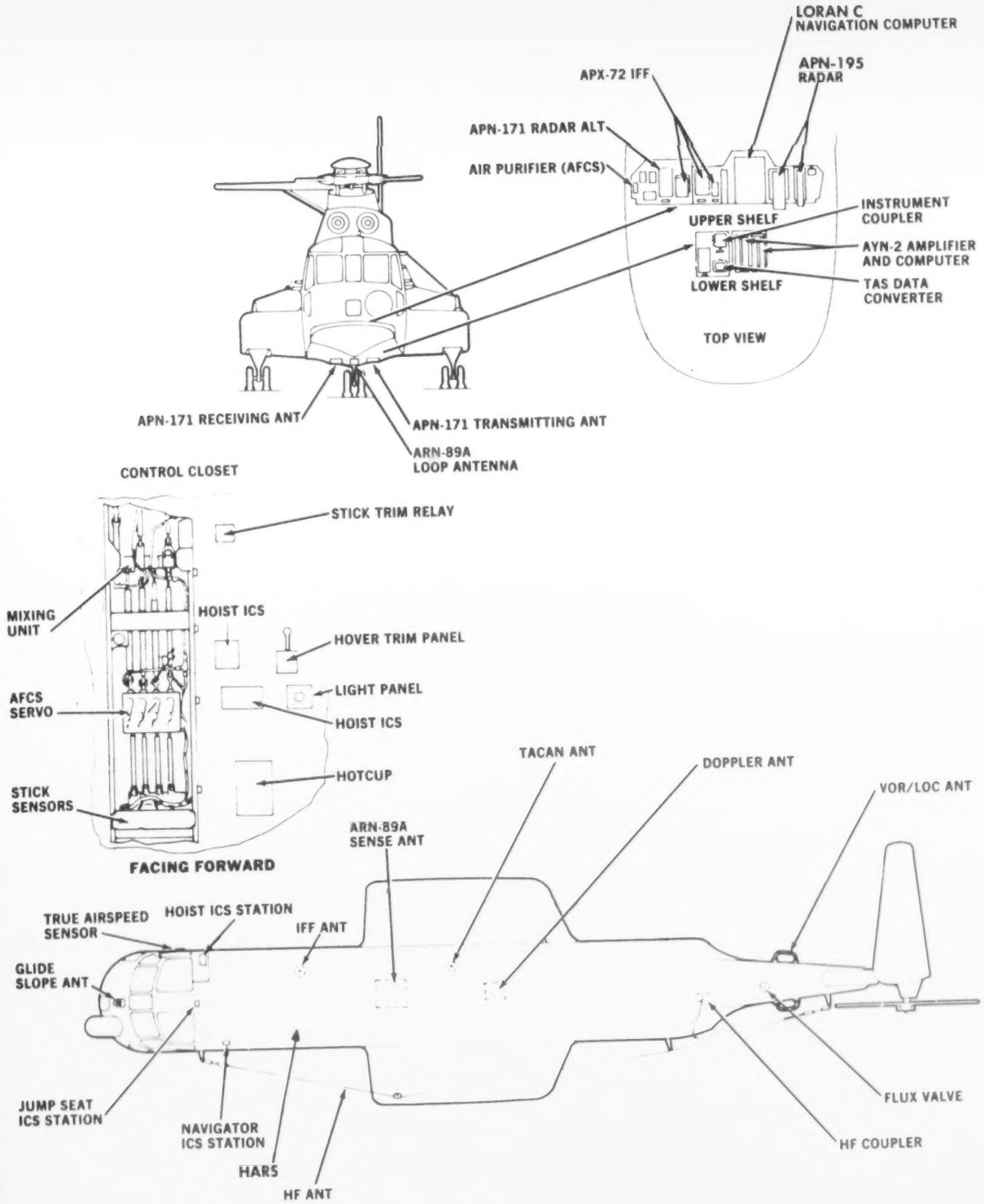


Figure 6-2. - Lower Cockpit Control Panels.



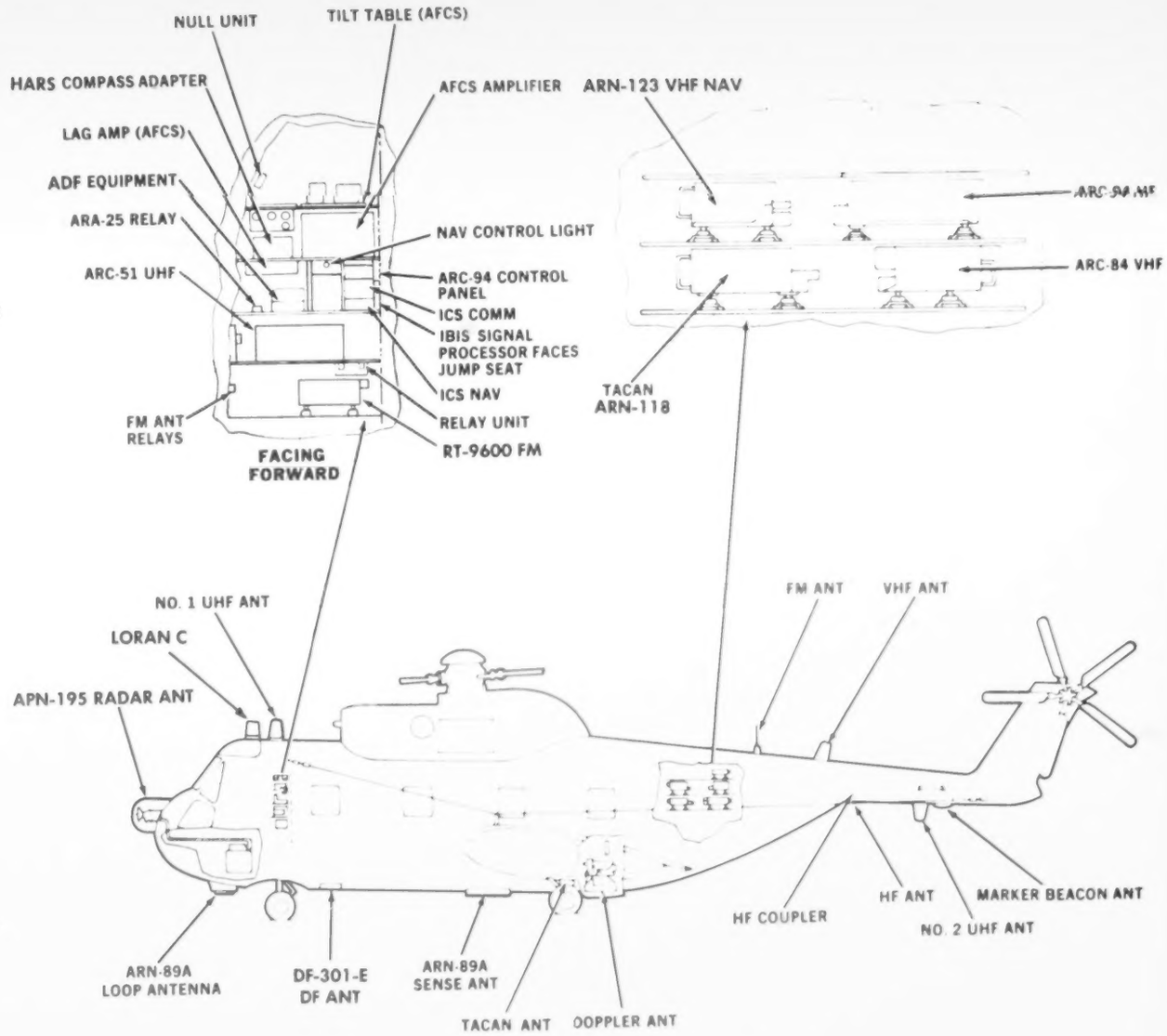


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Figure 6-3. - Antennas, Avionics, and AFCS Equipment.

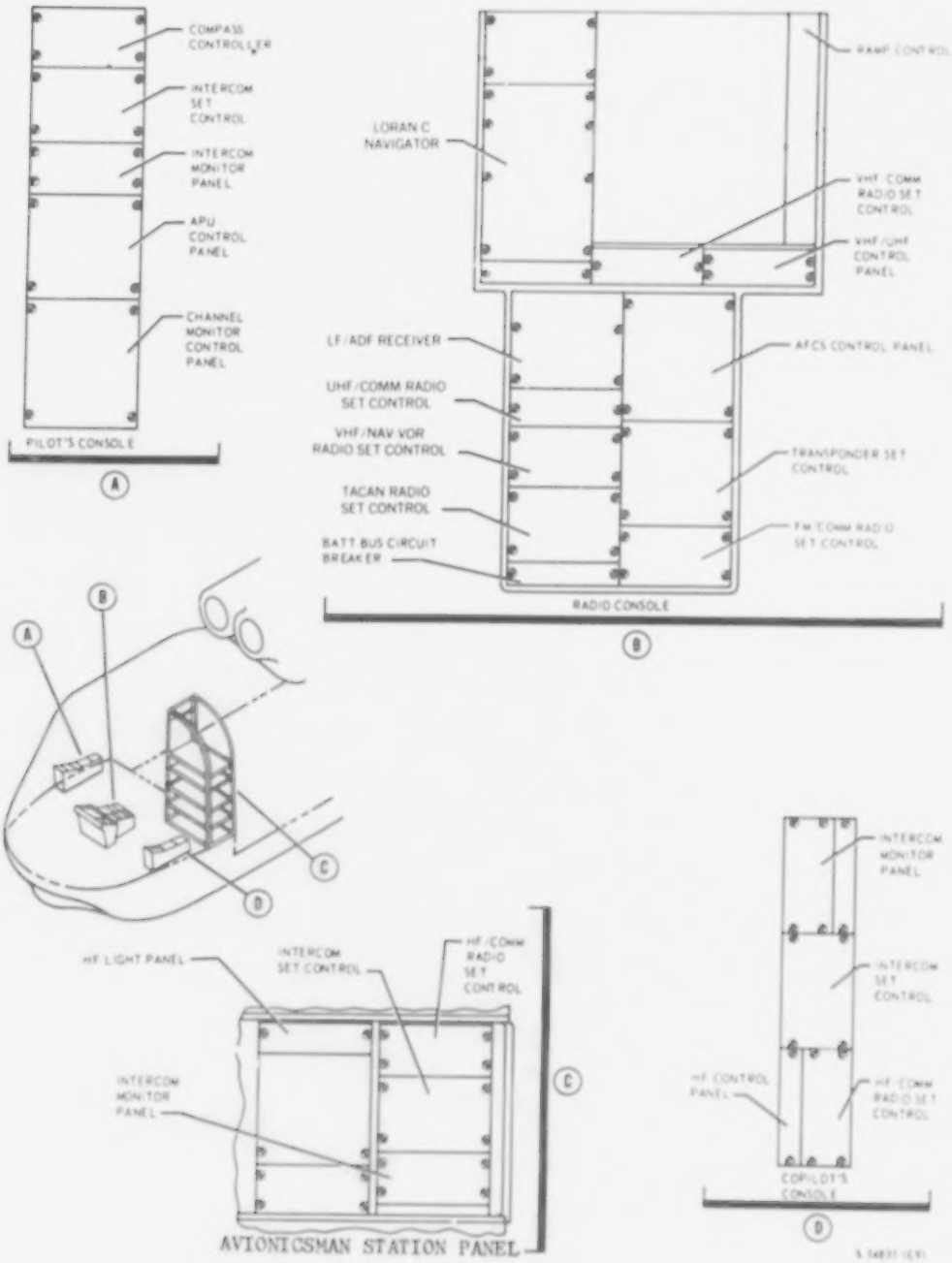

Figure 6-4. - Consoles and control panels - location diagram.

SYSTEM NOMENCLATURE AND DESIGNATION	SYSTEM COMMON NOMENCLATURE	PURPOSE OF SYSTEM
Intercommunication Set AN/AIC-18	INTERCOM	Provides intercommunication between stations within helicopter. Also provides selection, control, audio, and monitoring of communication and navigation systems.
Radio Set AN/ARC-51A	UHF/COMM	Provides short-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Radio Set AN/ARC-94	HF/COMM	Provides long-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Radio Set AN/ARC-84	VHF/COMM	Provides medium-range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.
Transponder AN/APX-72(V)	IFF	Provides coded reply in response to interrogation for identification and navigation.
Heading Attitude Reference System A/A24G-39	Heading attitude reference system	Provides attitude and heading information in the form of continuous signal outputs representing displacement of helicopter about pitch, roll, and yaw axes.
Direction Finder DF-301	UHF-VHF-FM/ADF	Provides pointer indication of relative bearing to UHF, VHF and FM radio transmitter sources for homing.
Direction Finder Set AN/ARN-89A	LF/ADF	Provides visual indication of relative bearing to LF transmitter signal source for navigation and homing.
Tacan Navigational Set AN/ARN-118	TACAN	Provides bearing and distance information with respect to geographical location of TACAN ground beacon. Also air-to-air ranging between helicopters and beacon identity information.

Figure 6-5. - Communication and Navigation Systems.

SYSTEM NOMENCLATURE AND DESIGNATION	SYSTEM COMMON NOMENCLATURE	PURPOSE OF SYSTEM
Navigation Set AN/ARN-123(V)	VHF/NAV-VOR	Provides course deviation with respect to localizer beam. Also provides course deviation and ambiguity information to VOR station.
	Glide-slope	Provides course deviation with respect to glide-slope beam.
	Marker beacon	Indicates that helicopter has passed over airway fan markers, station location Z markers, or approach markers of instrument landing system.
Radar Altimeter Set AN/APN-171	Altimeter	Provides visual indication of terrain clearance from 0 to 5,000 feet.
Radar Set AN/APN-195	Search radar	Provides accurate and continuous picture of weather conditions (weather map) in general sky area ahead of helicopter. Also used for navigation and search aid.
Loran C Navigator	LORAN C	Provides continuous navigation information and steering in LORAN C coverage areas.
Loran-A Navigation System AN/APN-180	Loran	Provides Loran chart navigation data to COMPUTER/NAV system or Loran lines of position fix when used independently.
Navigation Computer Set AN/AYN-2	FLIGHT/NAV	Provides an easily interpreted pictorial display of helicopter navigation situation and automatically computes required action necessary to obtain desired radio track or heading.
Radio Set RT-9000	VHF-FM/COMM	Provides medium range voice transmission and reception from helicopter-to-helicopter or helicopter-to-ground.

Figure 6-5. - (Continued).

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROL
Intercommunication System	AN/AIC-18	Interphone and radio communication	Internal	At the following stations: pilot, copilot, avionicsman, jump seat, hoist operator and aft cabin station
UHF/COMM	AN/ARC-51A	Two-way voice communication	Line of sight	Cockpit console
VHF/COMM	AN/ARC-84	Two-way voice communication	Line of sight	Cockpit console
HF/COMM	AN/ARC-94	Two-way voice communication	Long range	Copilot console, avionicsman's, console
IFF Transponder	AN/APX-72	Identification azimuth, and range	Line of sight	Cockpit console
UHF-VHF/ ADF	DF-301	Automatic direction finding	Line of sight	Cockpit console
VHF/FM	RT-9000	VHF/FM transceiver in 150.000 to 173.995 MHz frequency range	Line of sight	Cockpit console
VHF/NAV	AN/ARN-123	ILS, VOR, Glide Slope and Marker Beacon receiver	Line of sight	Cockpit console
TACAN	AN/ARN-118	Tactical air navigation	Line of sight	Cockpit console
LF/ADF	AN/ARN-89A	Automatic direction finding	Long range	Cockpit console

Figure 6-6. - Electronic equipment (HH-3F).

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROL
Radar Altimeter	AN/APN-171(V)	Measure absolute altitude	5,000 feet	Instrument panel
Radar	AN/APN-195	Weather search and navigation	60 miles	Instrument panel
LORAN C Navigator	AN/ARN-133(V)	Loran C Navigation computer	N/A	Cockpit console
Flight Director	AN/AYN-2	Present visual readout of navigation radio aid receivers	N/A	Instrument panel

Figure 6-6. - Electronic equipment (HH-3F) (Continued).

INTERCOMMUNICATION SYSTEM (ICS) AN/AIC-18

The AN/AIC-18 intercommunication system (ICS) provides communication between the various crewmembers. The ICS also links the audio channels of the communication and associated electronic equipment to provide simplified control and simultaneous operation. The system is controlled through identical ICS control and monitor panels provided for the pilot, copilot, and avionicsman (figures 6-7 and 6-9). In addition, the copilot has a remote ICS switch. The hoist station is equipped with a monitor panel, ICS station, and a hot mike switch (figure 6-11). The cabin aircrewman's station (jump seat) is equipped with an ICS station and a monitor panel (figure 6-8). The aft cabin station is equipped with an ICS station and a hot mike switch (figure 6-8).

The ICS circuits for the pilot, copilot, avionicsman, and crewman are powered by the DC primary bus. The forward and aft exterior ICS receptacles are on the crewman's ICS circuit (figure 6-10). When the aft external ICS receptacle is in use, the aft cabin ICS station is inoperative. The pilot's and avionicsman's ICS circuits are protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked PILOT and NAV under the general headings DC, PRI, and ICS. The copilot's and crewman's ICS circuits are protected by circuit breakers on the copilot's circuit breaker panel. The circuit breakers are marked CO-PLT and CREW under the general headings DC, PRI, and ICS.

NOTE

If any of the ICS circuit breakers pop, complete communication capability (ICS, CALL, RADIOS, and HOT MIKE) is lost to the respective position.

ICS CONTROL

The ICS control, marked INTER, is a panel mounted assembly on the pilot's, copilot's and avionicsman's console. All switches and control are front mounted except the external talk switch. Seven separate combination monitor selector-volume controls enable monitoring and individual listening level adjustment of the seven audio lines. The associated

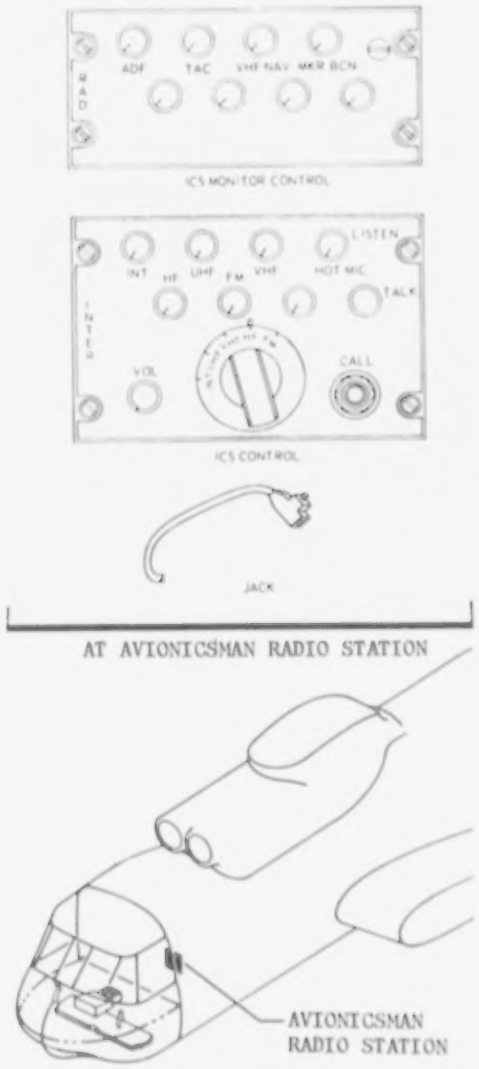

Figure 6-7. - ICS system avionicsman AN/AIC-18.

monitor switches are pulled out to monitor the desired audio lines. The level of the individual audio line is adjusted by rotating the associated monitor volume control. The six-monitor selector/volume controls used are marked: INT, UHF, VHF, HOT MIC LISTEN, HF, and FM. A HOT MIC TALK switch is also on this panel. A rotary selector switch enables transmission and reception on ICS or selected radio communications systems. The switch is marked INT, UHF, VHF, HF, and FM. The external talk switches control operation of the selected transmitter. The ICS control panel also contains a VOL control to adjust the signal level to the associated headphones, a HOT MIC TALK on-off switch, and a CALL button for emergency call operation.

The ICS controls provide four modes of microphone operation: one button, two button, HOT MIC, and CALL. The avionicsman has one-button operation, which provides a capability to talk on the interphone line or a radio transmitter, as selected by the rotary selector switch. Two-button operation is a mode whereby the pilot and copilot may talk on the interphone line or a selected radio transmitter without the need for operating the selector switch on the ICS control panel. The capability is provided by rocker switches on the pilot's and copilot's cyclic pitch stick. In addition, the copilot may talk on interphone or a selected radio by using the copilot's remote ICS switch. HOT MIC operation provides hand-free intercommunication. Call operation provides exalted intercommunication for high-priority or emergency messages. The call signal is heard at least six decibels louder than any other signal present.

ICS STATION

The ICS station is a bulkhead-mounted assembly with two controls mounted on the front panel. The VOLUME control adjusts the signal level to the headphones. The CALL button, which has a cap guard and chain, provides for emergency call operation on the interphone line. A plug connector and associated cable is used to connect the headset-microphone to the ICS station. The plug connector is a telephone jack with a push-to-talk switch and clip. (See figures 6-14 and 6-15.)

ICS MONITOR CONTROL

The monitor panel, marked RAD, is a panel mounted assembly with eight combination monitor selector/volume controls. At the pilot's, copilot's and avionicsman's consoles, only four are used, and they are marked ADF, TAC, VHF NAV, and MKR BCN. These monitor switch-volume controls permit monitoring of navigational systems which have output signals in the audio range. The hoist operator's and cabin aircrewman's stations are equipped with a monitor panel, marked RAD and HOIST OPERATOR, and seven of the eight monitor selector/volume controls are used. They are marked INT, UHF, HF, HOT MIC LISTEN, VHF, FM, and ADF. These controls permit monitoring and individual listening level adjustment.

HOT MIKE SWITCH

The hoist operator and aft cabin stations are equipped with a two-position HOT MIKE switch with the marked positions ON and OFF. This switch permits hands-free intercommunication. (See figure 6-11.)

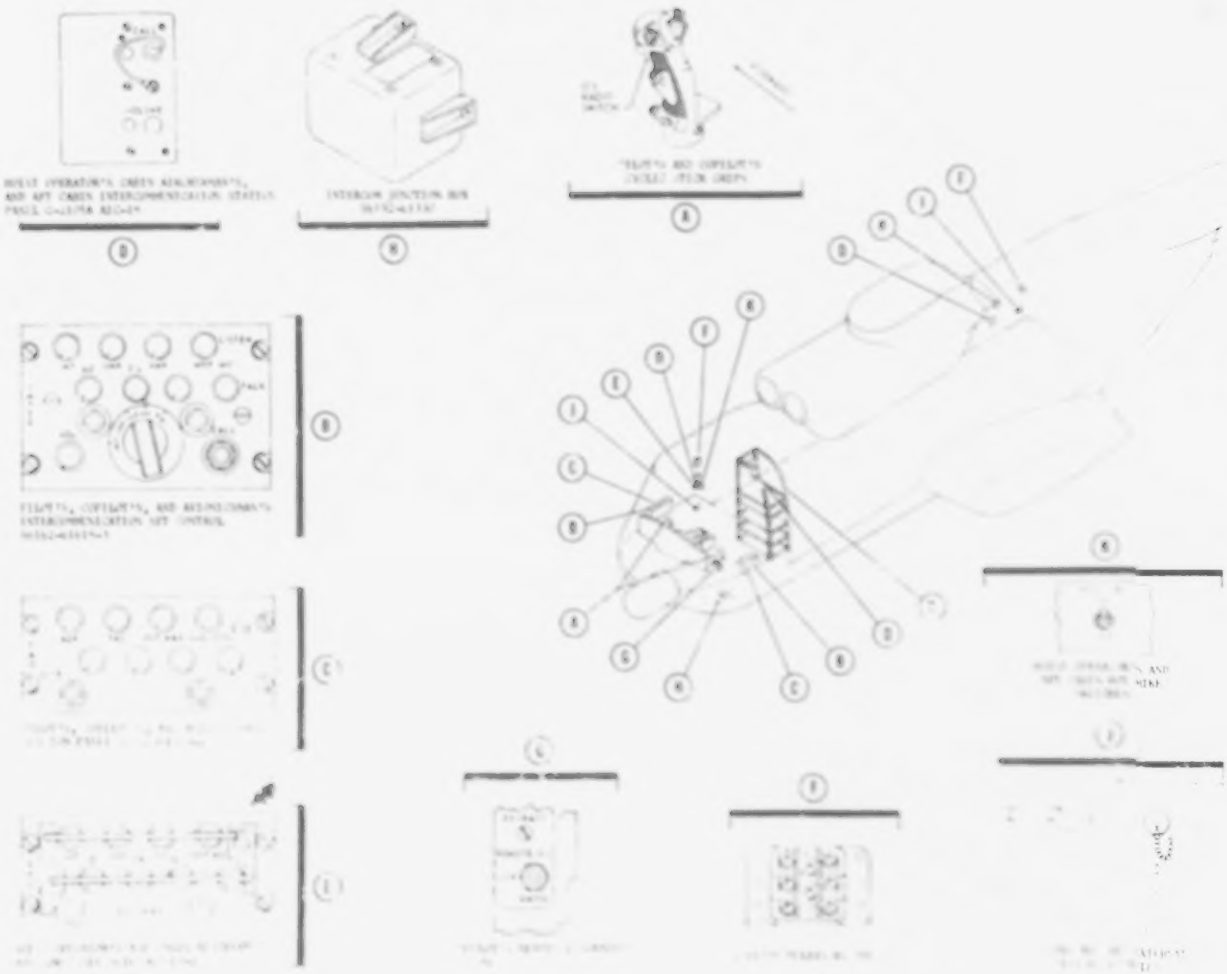

Figure 6-8. - INTERCOM system components - location diagram.

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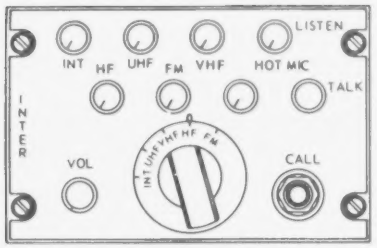
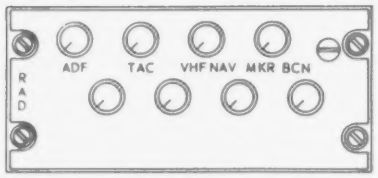
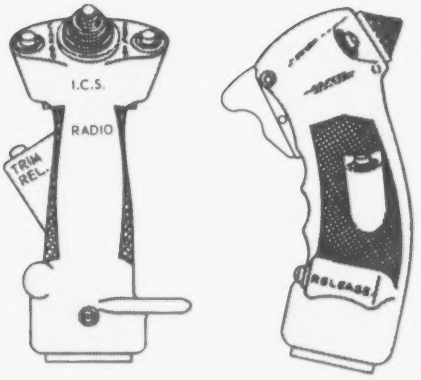


DETAIL A



DETAIL B



ICS ROCKER SWITCH, PILOT'S AND COPILOT'S
DETAIL C

ICS SWITCH PANEL, REMOTE, COPILOT'S
DETAIL D

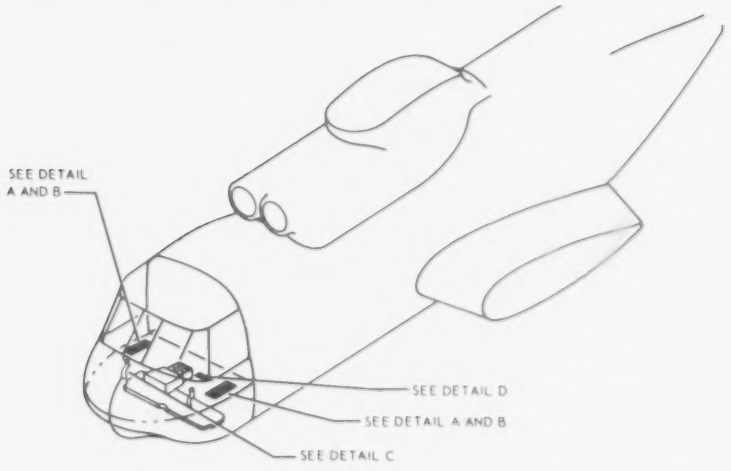


Figure 6-9. - ICS system pilot and copilot AN/AIC-18.

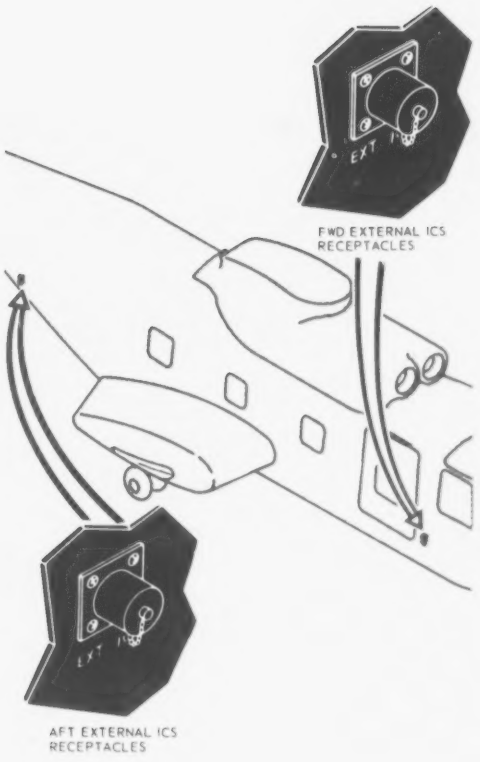


Figure 6-10. - ICS External stations AN/AIC-18.

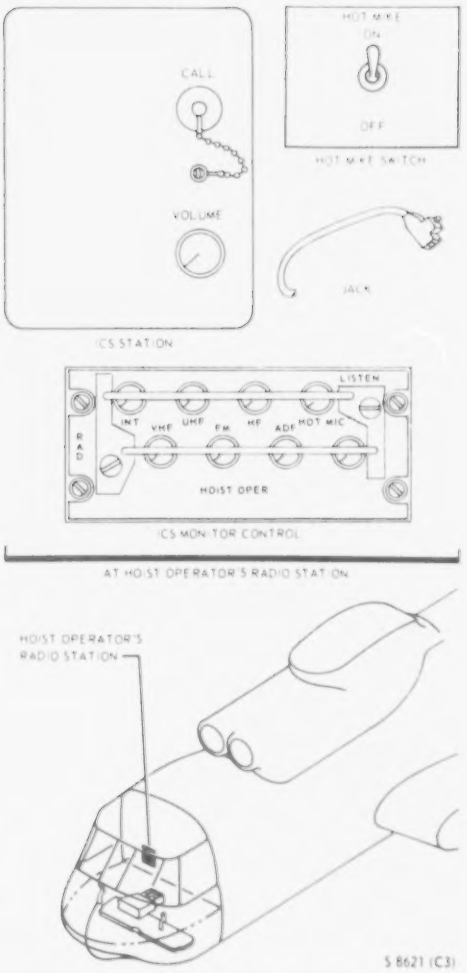


Figure 6-11. - ICS system hoist operator AN/AIC-18.

COMPONENT	FUNCTION
Intercommunication Set Controls	Provides selection of communications reception-transmission and intercommunication control to pilot, copilot, and avionicsman stations.
Intercommunication Station Panels	Provides intercommunications for hoist operator, cabin aircrewman, and aft cabin stations. Cabin aircrewman and aft cabin stations are electrically connected to fore-and-aft external ICS receptacles.
Monitor Panels	Provides additional monitoring circuits for pilot, copilot, avionicsman, cabin aircrewman, and hoist operator stations.

Figure 6-12A. - Intercom Equipment Components - Leading Particulars.

COMPONENT	FUNCTION
INTERCOM Junction Box	Provides load for and distributes intercommunication, communication, and navigation audio input and output signals.
ICS-RADIO Switches	Allows pilot and copilot to key INTERCOM system or selected communication system. Provides ground path when pressed to ICS or RADIO.
Microphone Switch Cord Assembly	Allows avionicsman to key selected INTERCOM or communication systems. Allows crewman to key INTERCOM system.
Headset Microphone Copilot REMOTE ICS-RADIO Switch	Provides means of communication. When positioned to ICS, allows copilot hands-off INTERCOM key operation. Spring-loaded RADIO position returns to OFF when released.
External fore-and-aft ICS receptacles	Provides electrical connection to cabin aircrewman and aft cabin stations for outside helicopter communications.
Hot Mike Switches	Allows hoist operator and aft cabin stations to transmit on hot mike.
Junction Box	Provides electrical connection for crewman's microphone switch cord assembly.

Figure 6-12B. - Associated Equipment Components.

STATION	NORMAL INTERCOM	CALL INTERCOM	HOT MIKE INTERCOM	COMM/NAV RECEPTION	COMM TRANSMISSION
Pilot	X	X	X	X	X
Copilot	X	X	X	X	X
Avionicsman	X	X	X	X	X
Hoist Operator	X	X	X	X	
Aft Cabin	X	X	X		
Cabin Air Crewman	X	X		X	

Figure 6-13. - Station Modes of Operation.

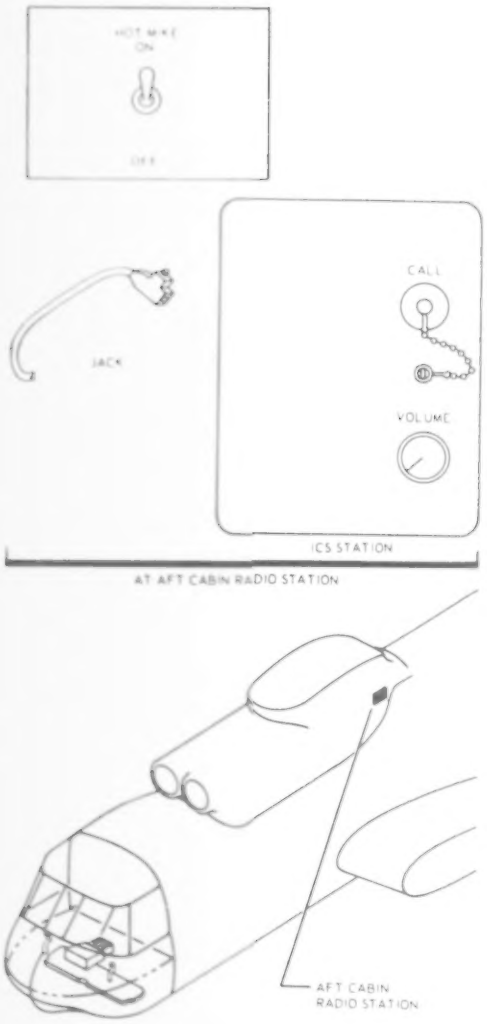


Figure 6-14. - ICS system aft cabin station AN/AIC-18.

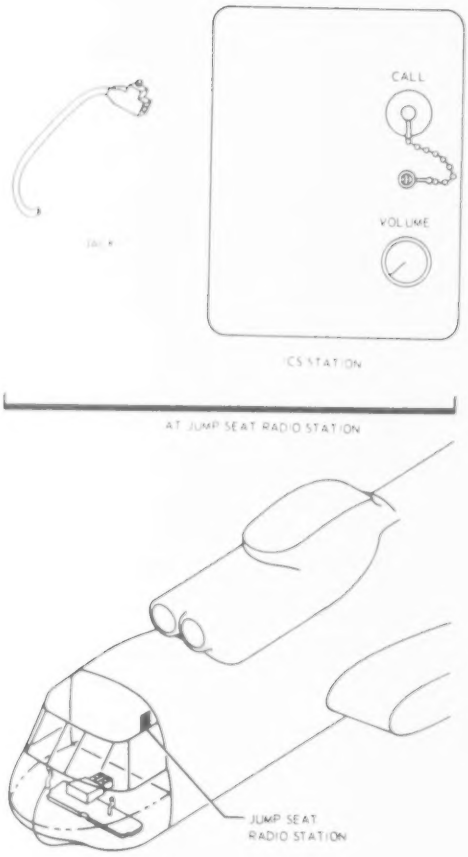


Figure 6-15. - ICS system jump seat AN/AIC-18. (Radio monitor panel not shown)

UHF/COMM RADIO SET AN/ARC-51A

The UHF/COMM system AN/ARC-51A is composed of a receiver-transmitter and a control panel. The set provides two-way voice communication between land-based, seaborne, or airborne stations. This can be accomplished on any one of 20 preset frequencies, or by manually selecting any one of 3,500 channels spaced at 50 KHz intervals within the equipment's frequency range of 225.0 through 399.95 MHz. The radio set includes a guard receiver which permits continuous monitoring of the guard frequency at the same time the main transmitter receiver is tuned to a tactical frequency. In addition, the radio set provides automatic direction finding (ADF) in conjunction with the direction finding group DF-301. Magnetic bearing will be displayed by the NO. 1 pointer on both RMI's.

The UHF/COMM system is equipped with two antennas. The antenna normally used is located above the cockpit, and the alternate antenna is located aft on the bottom of the pylon. The alternate antenna is used to eliminate UHF transmission and reception dead spots. The An/ARC-51A UHF radio set is powered from the No. 2 AC primary bus and the DC primary bus. The circuits are protected by circuit breakers on the pilot's circuit breaker panel. The AC circuit breaker is marked UHF under the general heading NO. 2 AC PRI. The DC circuit breaker is marked UHF under the general headings DC and PRI.

UHF/COMM CONTROL PANEL

The operating controls on the AN/ARC-51A radio control panel (figure 6-16) are the function selector, the mode selector, the preset channel control, the preset channel indicator, the frequency selectors, the frequency display window, the volume control, and the squelch disable switch.

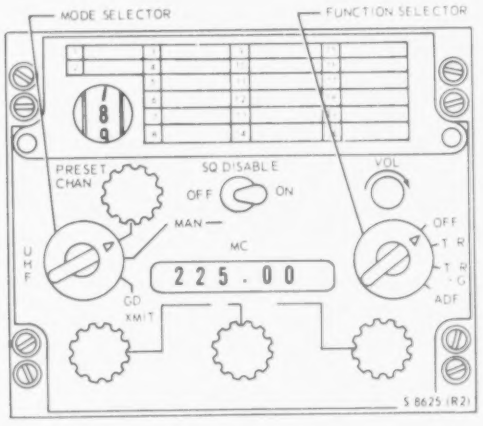


Figure 6-16. - UHF/COMM radio AN/ARC-51A.

Function Selector

The function selector has four positions: OFF, T/R, T/R + G, and ADF. In the OFF position, all power is removed from the equipment. The T/R position energizes the receiver-transmitter, and the T/R + G energizes the receiver-transmitter and guard receiver. In the ADF position, the DF-301 is energized to provide automatic direction finding operation.

Mode Selector

The mode selector has three positions: PRESET CHAN, MAN, and GD XMIT. The PRESET CHAN position permits selection of one of 20 preset channels by means of a preset channel control. In the MAN positions, 3,500 frequency channels may be selected by use of the manual frequency selectors. The GD XMIT position selects the preset guard frequency for the transmitter and receiver, with the function selector set at T/R. Setting the function selector to T/R + G, with the mode selector set at GD XMIT, turns the guard receiver on and places the transmitter, guard receiver, and main receiver on the guard frequency.

Preset Channel Control

The preset channel control selects any one of the 20 preset channels. The preset channel indicator displays the preset channel.

Frequency Selectors

Frequency selectors provide manual frequency selection when the mode selector is set at MAN.

VOL control

The VOL control adjusts the audio level of the receiver.

SQ Disable Switch

The SQ DISABLE switch has two positions. In the ON position, the receiver squelch is disabled. In the OFF position, the receiver squelch circuit is unaffected.

Antenna Selector Switch

The antenna selector switch, marked FORWARD and AFT, is on the UHF ANTENNA switch panel (figure 6-17) located on the center console.

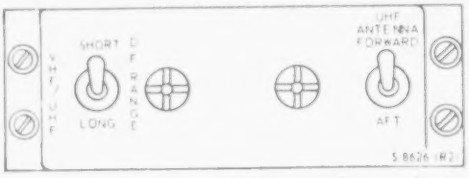


Figure 6-17. - UHF switch panel.

UHF/COMM OPERATION

To Turn Set On:

1. Function Switch (UHF/COMM Control Panel) - AS REQUIRED.
2. Antenna Switch (UHF ANTENNA Switch Panel) - AS REQUIRED. (See figure 6-17.)
3. ICS Monitor Selector/Volume Control - UHF.
4. ICS Transmit Selector Switch - UHF.
5. Squelch Disable Switch - OFF.
6. Volume Control Knob (UHF/COMM Control Panel) - AS REQUIRED.
7. Mode Selector (UHF/COMM Control Panel) - AS REQUIRED.
8. Preset Channel Control (UHF/COMM Control Panel - AS REQUIRED.
9. To Transmit - DEPRESS THE MICROPHONE TRIGGER SWITCH ON THE CYCLIC STICK GRIP TO THE RADIO POSITION, AND SPEAK INTO THE MICROPHONE.

To Secure Set

1. Function Switch (UHF/COMM Control Panel) - OFF.

EXTERNAL RELAY K8 MS24568 D1
EXTERNAL RELAY K7 MS24568 D1
NOTE 11
SEALER
UHF NO. 1 AND NO. 2 ANTENNA AT-256A ARC 51A INSTALLATION
S 34838 (C9)
ELECTRONIC EQUIPMENT AIR COOLER MD 533 ARC
MOUNTING MT-2653 ARC
STANDING WAVE RATIO INDICATOR ID 1001 ARC
RECEIVER TRANSMITTER RT-743 ARC 51A
VHF UHF CONTROL PANEL 56192 61350-2
COAXIAL RELAYS RE 120 ARA 25 AND RELAY MOUNTS MT 1042 ARA 25
RADIO SET CONTROL C 6476 ARC 51A
RELAY BOX RELAYS P O K2 AND K3
COAXIAL RELAYS RE 120 ARA 25 AND RELAY MOUNTS MT 1042 ARA 25 NOTE 1
COAXIAL RELAY RE 120 ARA 25 AND RELAY MOUNT MT 1042 ARA 25
NOTES
1. ON HELICOPTERS MODIFIED BY T.C.T.O. 1H-3M-F 551

Figure 6-18. - UHF/COMM system components - location diagram.

SELF-QUIZ # 6

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The HH-3F has a TOTAL of _____ ICS stations.

A. two
B. four
C. six
D. eight

2. Two-button operation is a mode of microphone operation provided by the ICS controls. By selecting this mode, the pilot has _____.

A. the capability to talk on the interphone line as selected by the rotary selector switch
B. the capability to talk on the interphone line without operating the selector switch on the ICS control panel
C. free-hand intercommunications
D. exalted intercommunication for high-priority messages

3. Which stations are equipped with a "Hot-Mike" two-position toggle switch?

1. Pilot
2. Copilot
3. Avionicsman
4. Hoist operator
5. Aft cabin

A. 1 and 3 only
B. 4 and 5 only
C. 1, 2, and 4 only
D. 1, 2, 4, and 5

4. The antenna normally used for the UHF/COMM system is located _____.

A. above the cockpit
B. on the right side of the fuselage
C. aft on top of the pylon
D. aft on the bottom of the pylon

5. The AN/ARN-51A UHF radio set gets its power from _____.

A. 28V DC and No. 2 AC radio bus
B. 26V DC and No. 1 AC radio bus
C. No. 1 AC primary bus and DC primary bus
D. No. 2 AC primary bus and DC primary bus

6. The UHF antenna selector switch is located on the _____.

A. instrument panel
B. overhead switch panel
C. center console
D. radio control panel

ANSWERS TO SELF-QUIZ #6

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	6-10
2	B	6-12
3	B	6-12
4	A	6-19
5	D	6-17
6	C	6-18

Reading Assignment:
Pages 7-1 through 7-8

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. RT-9600 VHF-FM
2. AN/ARC-84 VHF
3. AN/ARC-94 HF
4. AN/APX-72 IFF

8

VHF-FM/COMM RADIO SET RT-9600

The VHF-FM COMM System RT-9600 is composed of a receiver-transmitter and a control panel. The set provides two-way voice communications between land based, seaborne, or airborne stations. The communications may be on any one of 9600 manually selected channels spaced at 2.5 kHz increments in the 150.000 to 173.9975 MHz frequency range. The set includes a two channel guard receiver with a priority interrupt function. These guard channels can be set to any frequency in the 150.000 to 173.9975 MHz range. The international VHF-FM guard frequency is 156.800 MHz. The RT-9600 is used in conjunction with the DF-301 Homer. It is powered by the DC Primary Bus and is protected by a circuit breaker marked FM on the pilot's overhead circuit breaker panel under the general headings DC, PRI, and VHF.

VHF-FM/COMM CONTROL PANEL.
(See figure 7-1.)

The C-9861 used with the RT-9600 has 11 preset and 9600 manual channels. The preset channels are programmed in the C-9861 by the placement of diodes in the printed circuit boards. The frequency information is sent over 17 wires in binary form (BCD Binary Coded Decimal, to the RT-9600.

The 11 preset channels in the C-9861 can be operated simplex or duplex, with or without tone squelch by the placement of diodes on the channel cards with no limitations on the transmit to receiver frequency spacing.

VHF-FM/COMM OPERATION
To Turn Set ON

1. Function selector switch (VHF-FM/COMM control panel) - AS REQUIRED.
2. ICS receiver select switch - FM - ON.
3. ICS transmit select switch - FM.
4. Frequency selector switches (VHF-FM/COMM control panel) - AS REQUIRED.
5. HI LOW PWR switch (VHF-FM/COMM control panel) - AS REQUIRED.
6. VOL. control knobs (VHF-FM/COMM control panel - AS DESIRED.
7. Squelch control knobs (VHF-FM/COMM control panel) - AS REQUIRED.

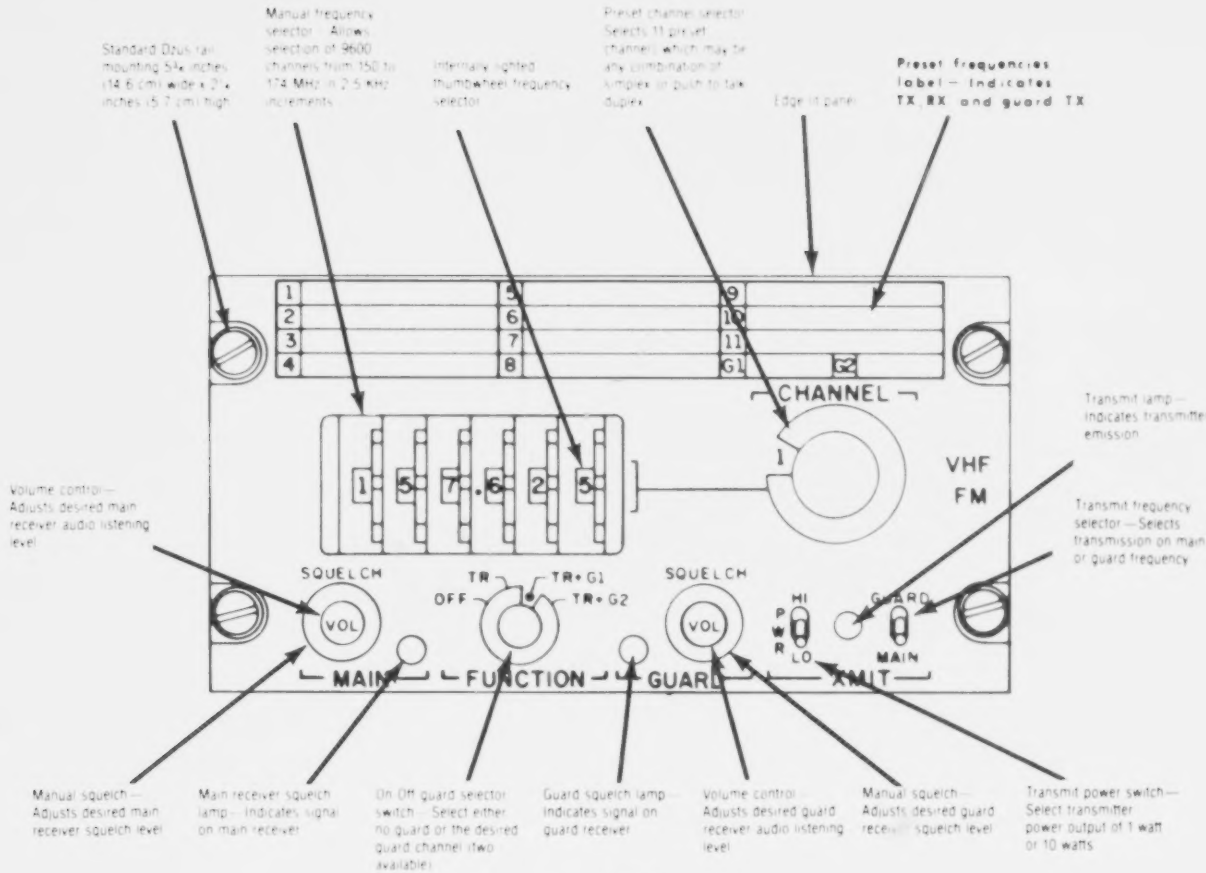

Standard Dzus rail mounting 5¼ inches (14.6 cm) wide x 2¼ inches (5.7 cm) high
Manual frequency selector—Allows selection of 9600 channels from 150 to 174 MHz in 2.5 kHz increments
Internally lighted thumbwheel frequency selector
Preset channel selector—Selects 11 preset channels which may be any combination of simplex or push to talk duplex
Edge lit panel
Preset frequencies label—Indicates TX, RX and guard TX
CHANNEL
VHF FM
Transmit lamp—Indicates transmitter emission
Volume control—Adjusts desired main receiver audio listening level
Transmit frequency selector—Selects transmission on main or guard frequency
SQUELCH
VOL
OFF
TR
TR+G1
TR+G2
HI
PWR
LO
GUARD
MAIN
MAIN
FUNCTION
GUARD
XMIT
Manual squelch—Adjusts desired main receiver squelch level
Main receiver squelch lamp—Indicates signal on main receiver
On-Off guard selector switch—Select either no guard or the desired guard channel (two available)
Guard squelch lamp—Indicates signal on guard receiver
Volume control—Adjusts desired guard receiver audio listening level
Manual squelch—Adjusts desired guard receiver squelch level
Transmit power switch—Select transmitter power output of 1 watt or 10 watts

Figure 7-1.

VHF/COMM RADIO SET AN/ARC-84

The VHF/COMM system AN/ARC-84 is composed of a receiver, a transmitter, and a control panel. The set provides two-way voice communication between land based, seaborne and airborne stations. The transmitter and receiver are designed to operate on crystal controlled channels spaced 50 kHz apart. The range of the transmitter is 118.0 through 135.95 MHz, and the range of the receiver is 108.0 through 135.95 MHz. In addition, the receiver is designed to operate in conjunction with the DF-301 direction finder to allow VHF-ADF homing. Magnetic bearing will be displayed by the No. 1 pointer of both RMI's. The VHF receiver and transmitter are powered by the DC primary bus. The receiver and transmitter are protected by circuit breakers on the pilot's circuit breaker panel. The circuit breakers are marked RCVR and XMTR, respectively, under the general headings DC, PRI, and VHF.

VHF/COMM CONTROL PANEL

The operating controls are provided by a control panel (figure 7-3), marked COMM, located on the cockpit center console. The panel consists of two frequency selectors, the frequency display window, the off-on/volume control, a squelch control, a momentary VHF-ADF homing select switch, a VOR momentary check switch, and a mode selector switch.

Frequency Selectors

The frequency selectors mechanically select and display frequencies spaced 50 kHz apart over the 108.00 through 135.95 MHz range.

VOL OFF Switch

The VOL OFF switch provides power control to the radio set and adjusts the audio level of the receiver.

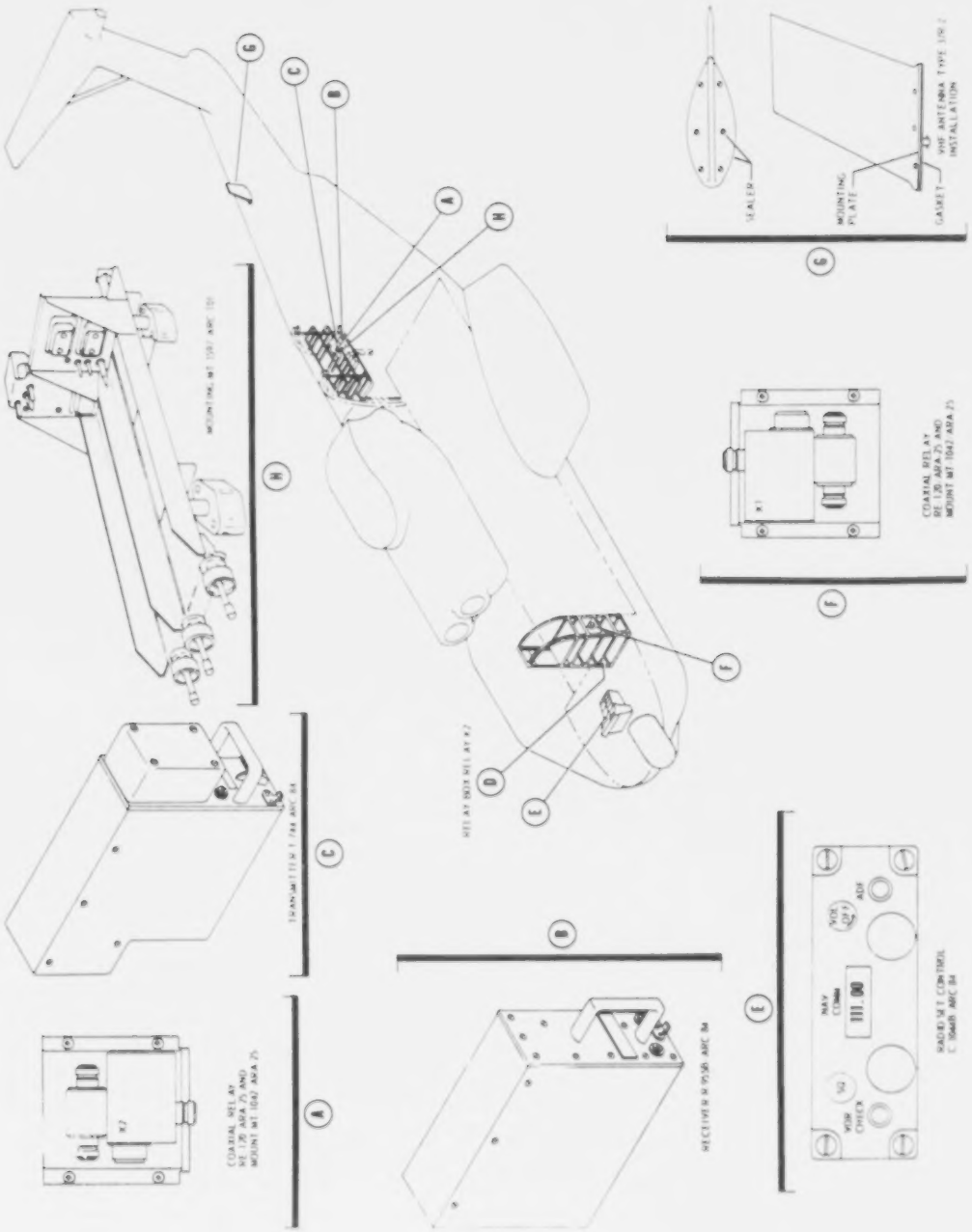


Figure 7-2. - VHF/COMM system components - location diagram.

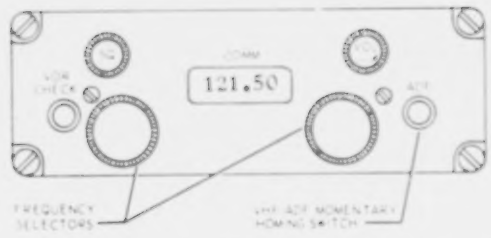


Figure 7-3. - VHF/COMM radio AN/ARC-84.

SQ Control

The SQ control eliminates receiver background noise.

ADF Switch

The momentary ADF homing select switch displays magnetic bearing with the No. 1 pointer of each RMI, as long as the switch is held down.

VOR Check Switch

The VOR momentary check switch is inoperative on the VHF/COMM control panel.

VHF/COMM OPERATION

To Turn Set On:

1. VOL OFF Switch (VHF/COMM Selector Panel) - ON.
2. ICS Monitor Selector/Volume Control - VHF.
3. ICS Transmit Select Switch - VHF.
4. Frequency Selectors (VHF/COMM Control Panel) - AS REQUIRED.
5. SQ Control (VHF/COMM Control Panel) - AS REQUIRED.
6. To transmit - DEPRESS THE MICROPHONE TRIGGER SWITCH ON THE CYCLIC STICK GRIP TO THE RADIO POSITION, AND SPEAK INTO THE MICROPHONE.

To Secure Set:

1. VOL OFF Switch (VHF/COMM Control Panel) - OFF.

HF/COMM RADIO SET AN/ARC-94

The HF/COMM system AN/ARC-94 consists of a receiver-transmitter, two control panels, an antenna, a coupler and a coupler blower. The system provides two-way voice communication between land-based, seaborne and airborne stations. The operating frequency range is from 2.0 to 29.999 MHz, divided into 28,000 discrete channels in one KHz increments. The HF/COMM system receives and transmits on either single sideband (USB or LSB) or amplitude modulated equivalent (AM). The receiver transmitter and the coupler blower are both powered by the No. 2 AC primary bus. The radio set uses 400-Hz three-phase 115-volt AC, and the coupler blower uses 400-Hz single-phase 115-volt AC power. Each unit is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is under the general heading NO. 2 AC PRI. The receiver and transmitter circuit breaker is marked HF, and the coupler blower circuit breaker is marked HF COUPLER BLOW ØB. The control circuit illuminates the avionicsman's HF (figure 7-7) control light and is powered by the DC primary bus. This circuit is protected by a circuit breaker on the pilot's circuit breaker panel. The circuit breaker is under the general headings DC PRI and is marked HF. (See figure 7-4.)

HF/COMM OPERATING CONTROLS

The system is remotely controlled by either one of two control panels (figure 7-5) marked HF. One control panel is located on the copilot's console and the other on the avionicsman's console. In addition, the copilot's console contains an HF/COMM switch panel (figure 7-6), with marked positions RADIO NAV and COPILOT. This switch permits the copilot to transfer control to or remove control from the avionicsman's control panel. The COPILOT position gives control of the set to the copilot, and the RADIO NAV position gives control of the set to the avionicsman. An advisory light (figure 7-7), marked HF CTR, is illuminated on the avionicsman's console above the HF/COMM control panel when the avionicsman has control. Both HF control panels contain a mode selector, four frequency selector knobs and associated display window, and an RF sensitivity control.

Mode Selector

The mode selector has four marked positions: OFF, USB, LSB, and AM. The OFF position removes aircraft power from the set. The USB position selects upper sideband operation, and the LSB position selects lower sideband operation. The AM position provides amplitude modulation operation of the radio.

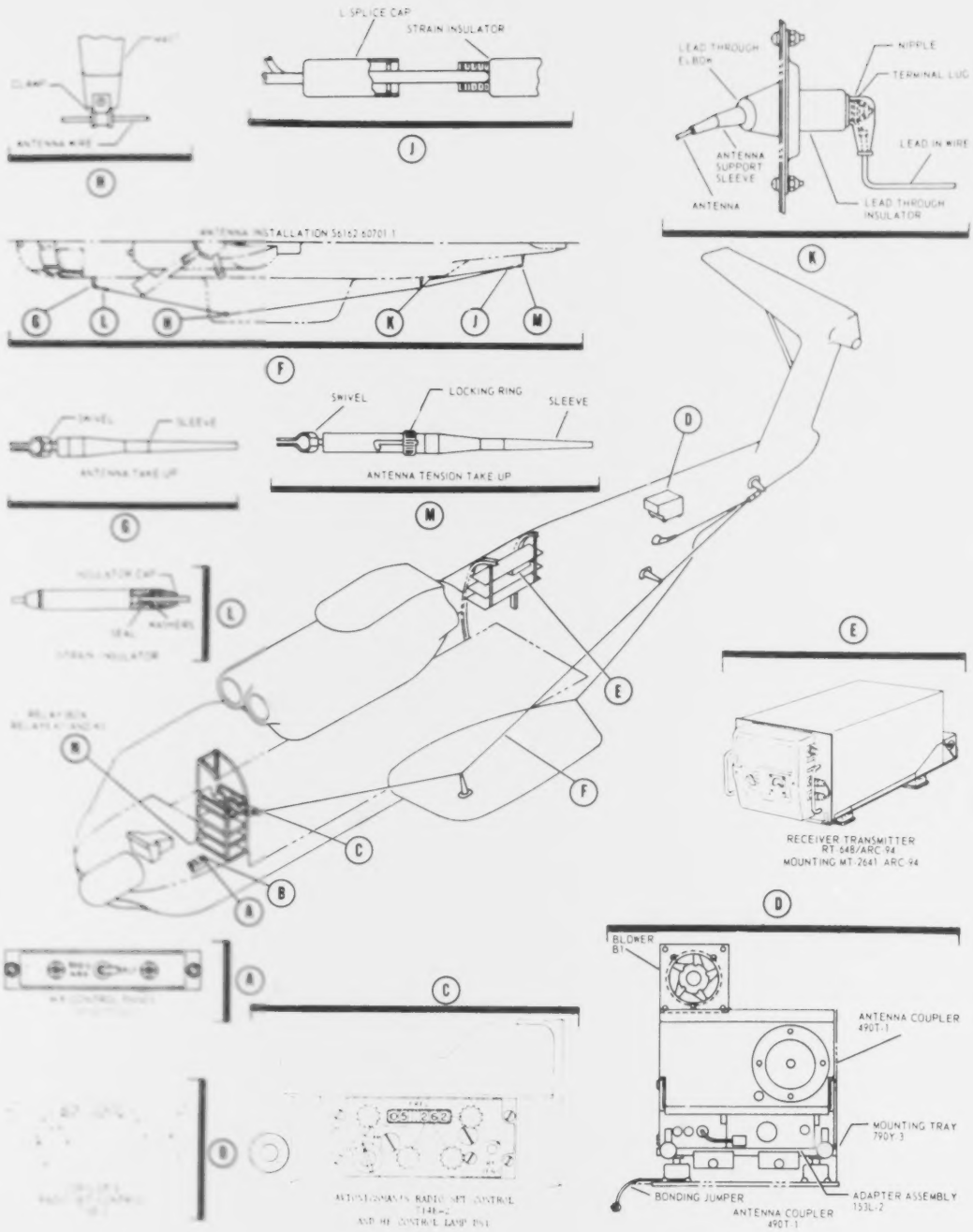


Figure 7-4. - HF/COMM system components - location diagram.

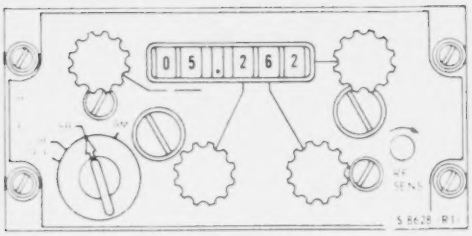


Figure 7-5. - HF/COMM radio AN/ARC-94.

Figure 7-6. - HF/COMM switch panel.

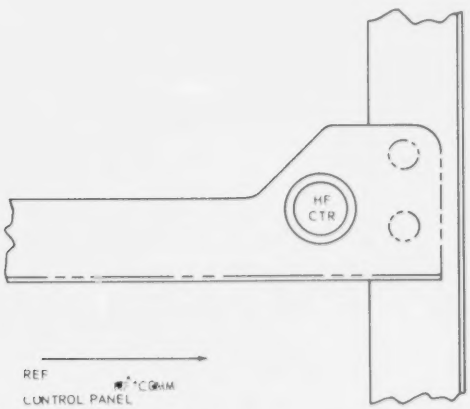


Figure 7-7. - HF/COMM control advisory light.

Frequency Control
(See figure 7-5.)
The control panels each have a frequency display window that reads in megahertz and four frequency selector knobs to select operating frequencies.

RF Sensitivity Control
AN RF sensitivity control marked RF SENS adjusts the receiver sensitivity of the receiver-transmitter.

WARNING

During ground operation of the AN/ARC-94, ensure that personnel are clear of the antenna. Serious burns may result if bodily contact is made with the antenna during ground operation.

WARNING

Do not transmit in 3.0 and 3.6 MHz range during doppler or coupler hover operation. Transmission in this range will result in erratic aircraft attitude.

HF/COMM RADIO SET AN/ARC-94 OPERATION

To Put The Equipment Into Operation:

1. HF/COMM Control Selector Switch (HF/COMM Switch Panel) - AS REQUIRED. (See figure 7-6.)
2. Mode Selector (HF/COMM Control Panel) - AS REQUIRED.
3. ICS Monitor Selector/Volume Control - HF.
4. ICS Transmit Selector Switch - HF.
5. Frequency Selector (HF/COMM Control Panel) - AS REQUIRED.

NOTE

While set is channeling, no background noise will be heard in the headset. The channeling cycle is complete when background noise is heard.

6. Microphone Switch - DEPRESS MOMENTARILY.

NOTE

When microphone switch is depressed, a one kHz tone will be heard in the headset. When the tone stops, antenna loading is complete and the set is ready for operation.

7. To Transmit - DEPRESS MICROPHONE

To Secure Equipment:

1. Function Selector Switch (HF/COMM Control Panel) - OFF.

AIMS/IFF TRANSPONDER AN/APX-72

The AN/APX-72 AIMS/IFF transponder is composed of a receiver-transmitter, a transponder set control, a transponder inflight test set, an altimeter

encoder, and an antenna. The transponder provides IFF identification in response to coded interrogations from ground, seaborne, or airborne stations. In addition, the signals returned from the IFF transponder can be used by the interrogating station to determine range and azimuth information. The IFF transponder is powered by the DC primary bus and the NO. 2 AC primary bus. These circuits are protected by circuit breakers on the pilot's circuit breaker panel. There are two DC circuit breakers, marked PWR and TEST under the general headings DC, PRI, and IFF. The AC circuit breaker is marked IFF ØA under the general heading NO. 2 AC PRI.

AIMS/IFF TRANSPONDER CONTROL PANEL

The transponder control panel (figure 7-8), marked IFF, is located on the cockpit console. The panel contains a master switch, mode enable toggle switches, code setting dials, an identification position (IDENT) toggle switch, mode 2 code setting dials, a RAD TEST-OUT-MON switch, and mode 4 controls.

Master Switch

The MASTER switch selects five conditions of operation: OFF, STBY, LOW, NORM, and EMER. In OFF, power is not applied to the set components. In STBY (standby), power is applied to components, the transponder is warmed up ready to respond, but no signals will be transmitted. In LOW, receiver sensitivity is reduced by a preset amount such that only higher energy signals will trigger the transponder. In NORM, the transponder will operate at normal sensitivity and respond to interrogations in accordance with settings of other controls. In EMER (emergency), emergency signal responses will be transmitted in modes 1, 2, or 3/A regardless of the settings of the mode control toggle switches. A detent prevents accidental selection of the EMER position. To bypass the detent, raise the center cap on the switch.

Mode Enable Toggle Switches

Four toggle switches, marked M-1, M-2, M-/A, and M-C, have three marked positions OUT, ON, and TEST. The OUT (down) position prevents responses in each mode. The ON (center) position permits responses in each mode. The TEST (up) position will illuminate the TEST light in the upper section of the control box if the transponder is replying.

NOTE

Mode C, when selected, operates in conjunction with the pilots AAU-21/A or AAU-32/A pressure altimeter-encoder to automatically provide encoded pressure altitude information from the helicopter to interrogating ground stations with Mode C decoding capability. Mode C operates independently of the other modes selected.

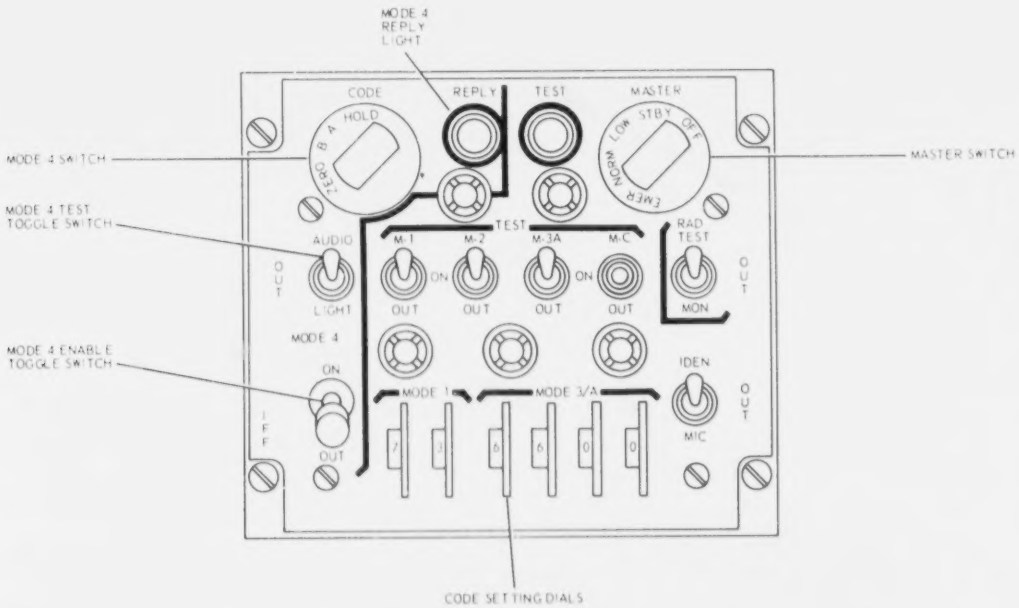


Figure 7-8. - AIMS/IFF Transponder AN/APX-72.

Code Setting Dials

Make desired mode 1 settings on the two numeral wheels marked MODE 1. MODE 1 selects a desired code from 00 through 73. Make the desired mode 3/A settings on the four numeral wheels marked MODE 3/A. MODE 3/A selects a desired code from 0000 through 7777. On the right side of each numeral, in the windows along the lower edge of the control box, is a protruding blunted spike. Light finger pressure on the spikes, either up or down, will rotate the numeral wheels.

Identification Position (IDENT) Toggle Switch

At the lower right of the control unit is a three-position toggle switch with the marked positions IDENT, OUT, and MIC. To provide approximately 20 seconds of IDENT signals on modes 1, 2, or 3/A, press this toggle switch momentarily upward to the IDENT position. A spring-load will return the switch to OUT or center position. To provide approximately 20 seconds of IDENT signals on those modes each time the UHF radio is keyed, set the toggle switch to MIC.

Mode 2 Code Setting Dials

Mode 2 settings must be made on the transponder front panel, marked MODE 2. Four numeral windows display the selected codes. Light finger pressure either up or down on the blunted spikes at the right of each numeral will rotate the numeral wheels. MODE 2 selects a desired code from 0000 through 7777.

NOTE

The transponder is located in the electronics compartment; therefore, MODE 2 settings must be made before flight.

RAD Test-Out-MON Switch

This switch is on the right center of the control unit. The RAD TEST position is used for maintenance test only. OFF disables the switch, and MON enables monitoring of the transponder replies to external interrogations. The TEST light will illuminate if the transponder is replying.

Mode 4 Controls

The mode 4 controls on the left side of the panel are inoperative in this installation.

SELF-QUIZ # 7

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The VHF-FM guard frequency is _____ MHz.

A. 156.800
B. 156.900
C. 158.800
D. 159.800

2. The main receiver squelch lamp on the C-961 illuminates when _____.

A. the RT-9600 is transmitting
B. the receiver squelch circuit fails
C. a signal is received in the main receiver
D. it is not safe to transmit

3. The frequency range of the AN/ARC-84 receiver is _____ MHz.

A. 108.0 - 135.95
B. 108.0 - 139.55
C. 118.0 - 135.95
D. 118.0 - 139.95

4. Which operative controls does the VHF/COMM control panel contain?

1. OFF-ON/volume control
2. Squelch control
3. Half duplex switch
4. VOR momentary check switch

A. 1 and 2 only
B. 3 and 4 only
C. 2, 3, and 4 only
D. 1, 2, 3, and 4

5. Which of the below is NOT a position on the HF/COMM mode selector?

A. AM
B. USB
C. LSB
D. ON

6. After the frequency selector on the AN/ARC-94 control is shifted to a new frequency, the equipment is ready for two-way communications when _____.

A. a frequency is selected
B. the tone stops
C. the channeling cycle is complete
D. a background noise is heard

7. The AN/APX-72 IFF transponder is capable of transmitting emergency signal responses in which mode(s)?

A. 1 only
B. 2 only
C. 3/A only
D. All of the above

ANSWERS TO SELF-QUIZ # 7

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	A	7-1
2	C	7-2
3	A	7-2
4	A	7-4
5	D	7-4
6	B	7-6
7	D	7-7

NAVIGATION SYSTEMS

Reading Assignment:
Pages 8-1 through 8-9

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the following HH-3F systems:

1. DF-301E Automatic Direction Finder
2. AN/ARN-123 OMNI, ILS, Marker Beacon receiver
3. AN/ARN-118 TACAN
4. AN/ARN-89 ADF

DIRECTION FINDER GROUP DF-301 (UHF/VHF/VHF-FM/ADF) SYSTEM

The direction finder indicates the relative bearing of, and homes on, signals received by the UHF, VHF and VHF-FM Communications systems. The DF-301 Direction Finder receives RF signals through its antenna and sends them to the associated UHF, VHF, or VHF-FM system which in turn sends back an audio signal to the DF-301. This audio is processed and changed into relative bearing information and fed to indicators in the cockpit. (See figure 8-1.) The relative bearing information is read as a continuous magnetic bearing by the No. 1 pointer of both pilot's RMI's.

The RF system is broadband from 100 to 400 MHz, therefore frequency selectivity must be accomplished by the associated communication receivers.

The DF-301E is comprised of two sections housed in a single unit: a solid-state UHF/VHF antenna, and switching control, filter/detector, servomotor control and power supplies. The cardiod pattern of the antenna is electronically rotated by a 5.68 KHz signal which reverses direction of rotation every 20 cycles. The DF-301E requires 27.5 VDC primary power and 26VAC 400 Hz indicator power.

AMPLIFIER AM-3969/AR

The radio frequency amplifier AM-3969/AR is used in conjuction with the DF-301E to amplify signals from a distant source. It is controlled by a panel located in the center console. (Figure 6-2.) When the switch is in the long position, the amplifier is turned on. When the switch is in the short position the amplifier is turned off.

NOTE

DO NOT USE the amplifier when homing on a signal source at close range, since the excessive RF strength may cause saturation of the system and loss of homing ability. Ensure that the switch is in the SHORT position.

RMI SELECTOR

An RMI selector switch is located on the instrument panel. (Figure 8-2.) It is marked NO. 1 LF/ADF and UHF/VHF DF. Ensure that this switch is in the UHF/VHF DF position when homing. This connects the NO. 1 needle on the RMI to the DF-301E.

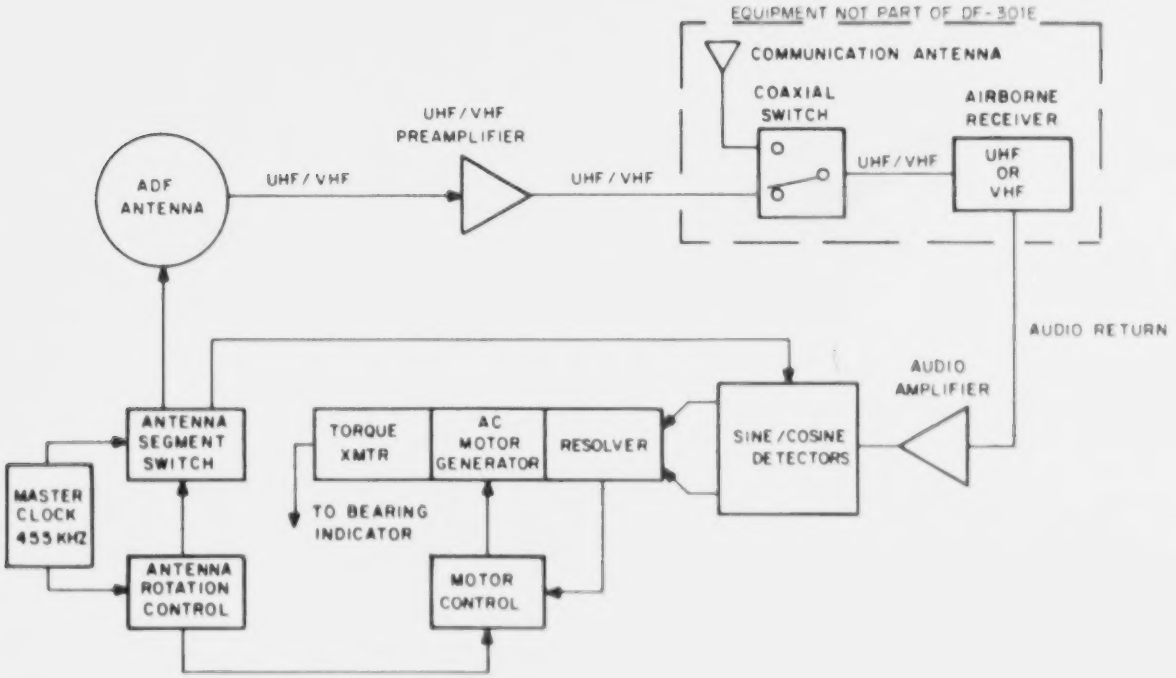


Figure 8-1. - ADF Functional Block Diagram.

DIRECTION FINDER OPERATION

To Turn Set On Using UHF/COMM System:

1. Function Switch (UHF/COMM Control Panel) - ADF.
2. ICS Monitor Selector/Volume Control - UHF.
3. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
4. Mode Selector (UHF/COMM Control Panel) - AS REQUIRED.
5. Frequency Selector (UHF/COMM Control Panel) - AS REQUIRED.
6. Volume Knob (UHF/COMM Control Panel) - AS REQUIRED.
7. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.

To Secure UHF/COMM Homing Feature:

1. Function Switch (UHF/COMM Control Panel) - AS REQUIRED.
2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

To Turn Set On Using VHF/COMM System:

1. ICS monitor Selector/Volume Control - VHF.
2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
3. VOL OFF Switch (VHF/COMM Control Panel) - ON.
4. Frequency Selectors (VHF/COMM Control Panel) - AS REQUIRED.
5. Squelch Control (VHF/COMM Control Panel) - AS REQUIRED.
6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.
7. Momentary ADF Switch (VHF/COMM Control Panel) - DEPRESS.

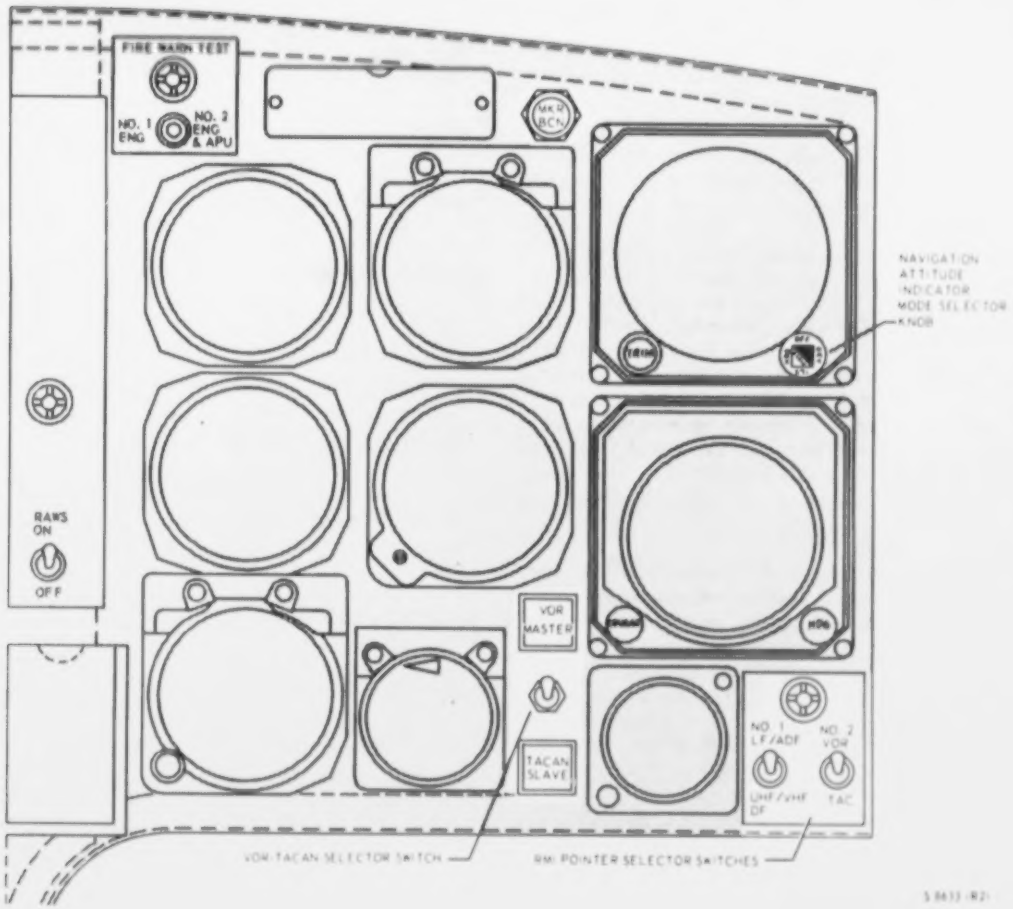


Figure 8-2. - Nav aid auxiliary controls for VOR, ILS, TACAN and ADF.

To Secure VHF/COMM Homing Feature:

1. Momentary ADF Switch (VHF/COMM Control Panel) - RELEASE.

To Turn Set On Using VHF/COMM System:

1. ICS Monitor Selector/Volume Control - FM.
2. RMI Pointer Selector (Instrument Panel) - UHF/VHF DF.
3. Frequency Selector Switches (VHF-FM Control Panel) - AS REQUIRED.
4. Volume Control (VHF-FM Control Panel) - AS REQUIRED.
5. Squelch Control (VHF-FM Control Panel) - AS REQUIRED.
6. RF Amplifier Switch (VHF/UHF Switch Panel) - AS REQUIRED.
7. Function Selector Switch (VHF-FM Control Panel - ADF.

To Secure VHF-FM/COMM Homing Feature:

1. Function Selector Switch (VHF-FM Control Panel) - AS REQUIRED.
2. RMI Pointer Selector (Instrument Panel) - LF/ADF.

VHF/NAV RADIO SET AN/ARN-123

The AN/ARN-123 receiver is a remotely located, integrated navigation package which contains a 200

channel VOR/LOC receiver, a 40 channel glide slope receiver, and a marker beacon receiver. The three receivers perform the intended mission of the unit without depending on each other.

Visual presentation of the localizer course, VOR (manual) course, and the glide slope is made on both the pilot's and copilot's attitude indicator and course indicators on the AN/AYN-2 flight director. Ambiguity in omni bearing information of a VOR (manual) course is resolved by the to/from arrow. Visual presentation of heading-sensitive (automatic) VOR bearing is made with the No. 2 pointer of the RMI's.

VHF OMNIRANGE (VOR)/LOCALIZER (LOC) RECEIVER SECTION

The VOR/LOC receiver section receives and processes VOR and localizer signals over a frequency range of 108.00 to 117.95 MHz, with a channel spacing of 50 KHz. Of the 200 channels available, 160 are for VOR operation and 40 are for LOC operation.

NOTE

Reverse sensing will be displayed on the OMNI Course Indicator and Flight Directors when inbound on a localizer back course approach.

GLIDE SLOPE (GS) RECEIVER SECTION

The GS receiver section processes glide slope signals over a frequency range of 329.15 to 335.00 MHz with a channel spacing of 150 KHz. Whenever one of the 40 localizer frequencies is selected the appropriate GS frequency is tuned on the GS receiver. Glide slope information is fed to the OMNI Course Indicator and the Flight Directors.

MARKER BEACON (MB) RECEIVER SECTION

The MB receiver section processes 75 MHz signals and converts them into an output that drives the marker beacon lights on the OMNI and TACAN Course Indicators and provides audio signals to the pilot's and copilot's ICS Control Panel, NAV switch.

VHF NAV RADIO CONTROL PANEL

The VHF NAV Radio control panel (figure 8-3) on the upper radio console (figure 8-4), contains a NAV VOL-OFF control, frequency indicator, frequency selector knobs, MB VOL-OFF control, MB Sensitivity switch (HI/LO), and a VOR/MB test switch.

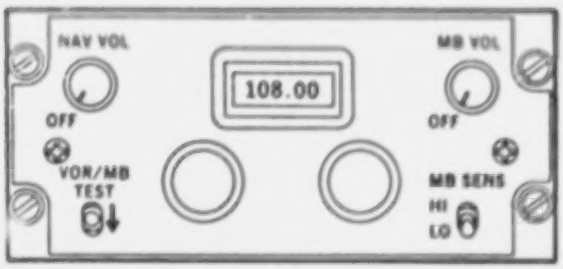


Figure 8-3. - AN/ARN-123 NAV Radio Control Panel.

VHF NAV RADIO OPERATION

To Turn The Set ON:

1. Radio master - ON.
2. NAV VOL-OFF control - ON, VOLUME AS DESIRED.
3. MB VOL-OFF control - ON, VOLUME AS DESIRED.
4. MB Sensitivity - HI.
5. Frequency selector knobs - AS DESIRED.

To Turn Set Off:

1. NAV VOL-OFF control - OFF.

NOTE

The NAV VOL-OFF control is the master power switch for the entire radio.

NOTE

If you lose AC power to the set, VOR course information will be lost. Localizer, glide slope, and marker beacon information will continue to be provided.

VOR/MB CHECK

1. Tune in a nearby VOR station.
2. OMNI course selector - 315 RADIAL.
3. VOR/MB test switch - HOLD IN TEST POSITION.
4. CDI needle - CENTERED PLUS OR MINUS 2 DOTS.

5. ±2 needle (VOR selected) - 315 RADIAL PLUS OR MINUS 5.

6. Both marker beacon lights - ON.

7. VOR/MB test switch - RELEASE.

SYSTEM APPLICATION
(SEE FIGURE 8-4.)

The airborne receiver basically consists of several operational sections. The glideslope receiver section provides the up/down deviation and flag alarm information to drive the glideslope loads of the VOR/ILS indicator (CDI) and the flight guidance systems. A VOR/LOC receiver section provides the left/right deviation, flag alarm and to/from information to drive the VOR/LOC loads of the VOR/ILS indicator (CDI) and the flight guidance systems.

In addition, automatic conversion of the VOR bearing provides relative bearing for driving the pointer of a Radio Magnetic Indicator (RMI). An audio output is also provided for voice and identification purposes. Finally, the marker receiver section provides a marker beacon output capable of driving a standard one-lamp system or, optionally, a three-lamp system. An audio output is provided for identification purposes. Three separate antenna jacks (glideslope, VHF NAV, and marker) are provided to accept the rf inputs for each of the corresponding receivers.

TACAN RADIO SET AN/ARN-118 (V) (TACTICAL AIR NAVIGATION)

The TACAN navigation system, AN/ARN-118(V), is a polar coordinate navigation system that is used to determine the relative bearing and line of sight distance from the aircraft to a selected TACAN station. The selected TACAN station can be ground, shipboard, or airborne. The ground and shipboard TACAN stations are considered surface stations and supply both bearing and line of sight distance to the helicopter. An airborne station only supplies line of sight distance information, unless the aircraft is especially equipped with a bearing transmitter.

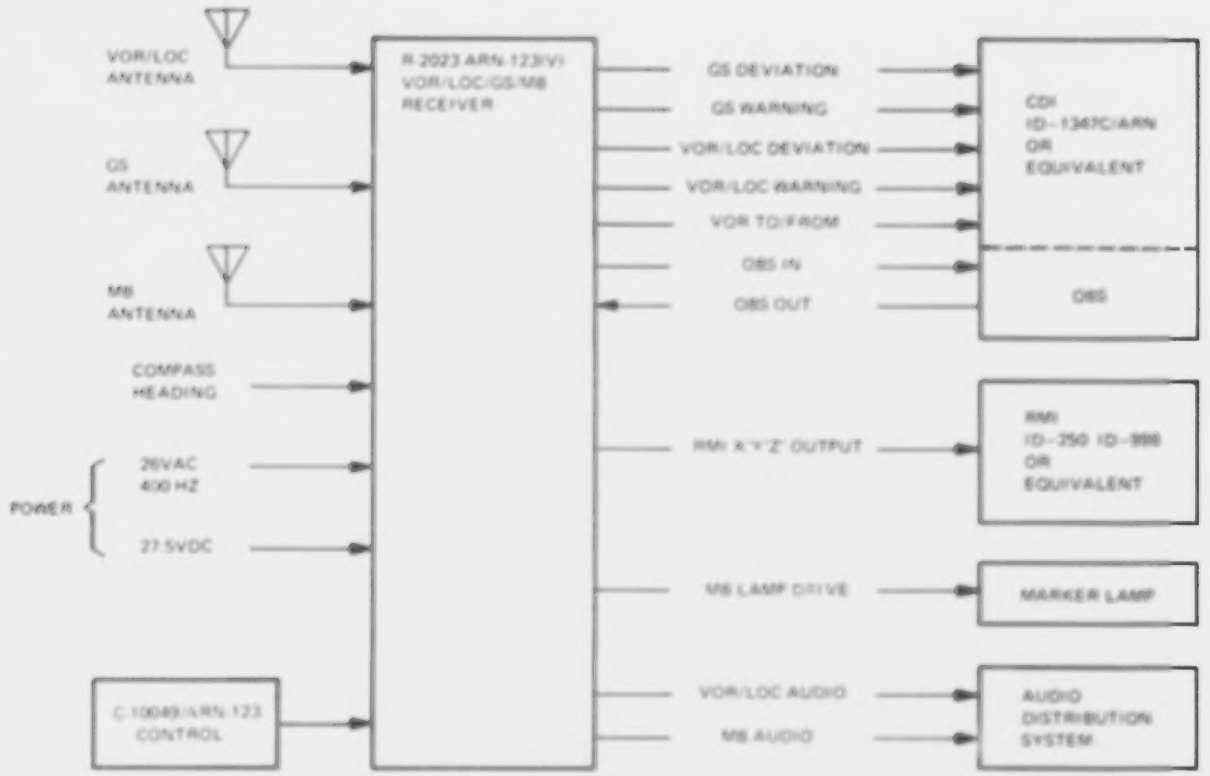


Figure 8-4. - System Application.

TACAN navigation set AN/ARN-118(V) is not capable of transmitting bearing information but does supply line of sight distance information when interrogated. The maximum range of station reception is governed by line of sight considerations. The maximum operating range of the set is 390 nautical miles when the selected station is a surface station, and 200 nautical miles when A/A operation is selected. The distance display on the course indicator is only capable of displaying a range up to 299 nautical miles. The TACAN navigation set has provisions for 126 X channels and 126 Y channels. The X channels are those presently in use by surface stations. The Y channels differ from the X channels in frequency assignment and pulse spacing.

NOTE

The Y channels were developed to alleviate congestion of the X channels, but have not been implemented in ground stations. They are, however, available for use in the A/A modes. Use of the Y channels in the A/A mode is encouraged to eliminate possible interference with ground stations.

Visual presentation of the TACAN course is made on the pilot's and copilot's course indicator of the AN/AYN-2 flight director and the RMI's. Ambiguity in TACAN bearing information of a TACAN (manual set) course is resolved by the to/from arrow. Visual presentation of (automatic) TACAN bearing is presented with the No. 2 pointer of both RMI's. The distance to a TACAN or VORTAC station or a cooperating aircraft is displayed in the distance display window of the course indicator. The distance is read in nautical miles.

The TACAN is powered by the DC primary bus, the No. 1 AC primary bus, and 26 volts AC from the radio autotransformer. The TACAN is protected by two circuit breakers on the copilot's circuit breaker panel. The TACAN's DC primary circuit is protected by a circuit breaker marked TACAN, under the general heading DC PRI. The TACAN's No. 1 AC primary circuit is protected by a circuit breaker marked TACAN OC, under the general heading NO. 1 AC PRI.

TACAN OPERATING CONTROLS

Controls for the TACAN system are located on the TACAN control panel on the center console (figure 8-5). These controls include a function selector switch, tens channel selector switch, units channel selector switch, X/Y channel selector, volume control knob, and self-test button. The control panel also contains a test indicator light and a channel digital display.

Function Selector Switch

A five-position (OFF, REC, T/R, A/A REC, A/A T/R) function selector switch selects the mode of operation. OFF removes power from the set. The REC position allows only bearing information to be received from a surface station. The T/R position allows both bearing information and line of sight distance data to be received from a surface station. The A/A REC position allows only bearing information to be received from a suitably equipped cooperating aircraft.

NOTE

The HH-3F helicopter and other Coast Guard aircraft are not suitably equipped to transmit bearing information to other aircraft. This does not prevent reception of bearing information by the helicopter from a suitably equipped aircraft of another service.

In the A/A T/R position both bearing and line of sight distance information are received from another aircraft. If the cooperating aircraft is not equipped to transmit bearing signals, only the line of sight distance will be received in this mode.

NOTE

Operation in the air-to-air mode requires prearrangement with a cooperatng aircraft. The second aircraft must be equipped with an air-to-air TACAN which is set to the air-to-air mode of operation and is set 63 channels away from the channel setting of the TACAN in the first aircraft. One aircraft may reply to as many as five others, but it will only display the distance to the nearest aircraft.

The TACAN navigation set requires a 90-second warm-up period regardless of the position selected by the function selector switch.

Channel Selector Switches

The tens channel selector and units channel selector are rotary switches that tune the TACAN navigation set to any of 126 TACAN channels. The X/Y channel selector selects either the X set of 126 channels or the Y set of 126 channels.

CAUTION

The units channel selector switch contains a built-in mechanical stop to prevent rotation past the nine (9) position. Do not attempt to override this mechanical stop. Direction of switch rotation must be reversed when the stop is reached.

Volume Control Knob

The volume control knob, marked VOL, varies the volume of the audio signals received from the selected surface station and heard through the helicopter intercommunication system when the appropriate monitor button is pulled out.

Self-Test Button

The manual self-test button, marked TEST, provides a test of a complete TACAN system, except for the antennas, when pressed.

Manual Self-Test of TACAN System

To initiate the self-test, select TACAN on the VOR-TACAN selector switches, select TAC on the RMI No. 2 pointer selector switches, select a course of 180 degrees in the copilot's course display window, place the TACAN function switch in the T/R position, and allow 90 seconds for warm-up. Depress the TEST button and observe that the test indicator light illuminates for about one second, the distance shutter and VOR-LOC flags come into view for approximately seven seconds, and the No. 2 pointers of the RMI's indicate 270 degrees. For the next fifteen seconds, the flags go out of view, the distance displays indicate 000.0 ($\pm$0.5), the No. 2 pointers indicate 180 ($\pm$3) degrees, the course deviation bar centers to within 1/2 dot and the to/from arrow indicates TO.

When the self-test is complete, all indicators return to the indications displayed prior to the self-test. A failure is recorded if the test indicator light remains on during the test and/or the indicators are out of limits. The test can be performed again in the REC mode, and if the indicator light does not come on, the malfunction is isolated to the transmitter section and the bearing information is valid.

Automatic Self-Test of TACAN System

An automatic self-test occurs when the receiver signal becomes unreliable or the signal is lost, to ensure that the TACAN system is operating properly. The results of the automatic self-test are the same as for the manual self-test except that the distance shutters and VOR-LOC flags remain in view throughout the test.

CAUTION

Bearing and/or distance indications may still be present when the TEST lamp is on. Such indications could be either partialy usable or grossly inaccurate. They should be cross-checked, using every available means. Be prepared for the possibility of TACAN equipment failure if the test indicator light illuminates.

TACAN OPERATION

To Turn Set On:

1. Function Selector Switch (TACAN control panel) - AS REQUIRED.
2. ICS Monitor Selector/Volume Control - pull TAC.
3. VOR-TACAN Selector Switch (Instrument Panel) - TACAN.
4. RMI No. 2 Pointer Selector Switch (Instrument Panel) - TAC.
5. Channel Selector Knob (TACAN Control Panel) - AS REQUIRED.
6. Volume Control (TACAN Control Panel) - AS REQUIRED.
7. Attitude Indicator Mode Selector Knob (Instrument Panel) - AS REQUIRED.

To Turn Set Off:

1. Function Selector Switch (TACAN Control Panel) - OFF.

LF AUTOMATIC DIRECTION FINDER SET (LF/ADF) AN/ARN-89

The LF/ADF set AN/ARN-89 (figure 8-5) provides automatic or manual compass bearings with the No. 1 pointer of the RMI on any radio signal between 100 and 3,000 kHz. The tuning range is continuous between these frequencies. The LF-ADF also may function as a low-frequency communications receiver.

The LF/ADF set is powered by the DC primary bus and 26 volts AC from the radio autotransformer. The LF/ADF set's DC primary circuit is protected by a circuit breaker on the pilot's circuit breaker panel marked LF ADF.

LF/ADF CONTROL PANEL

The LF/ADF control panel contains the OFF-COMP-AND-LOOP switch, CW-VOICE-TEST switch, coarse and fine frequency controls, kilohertz indicator, tuning indicator, audio control, and LOOP L-R control.

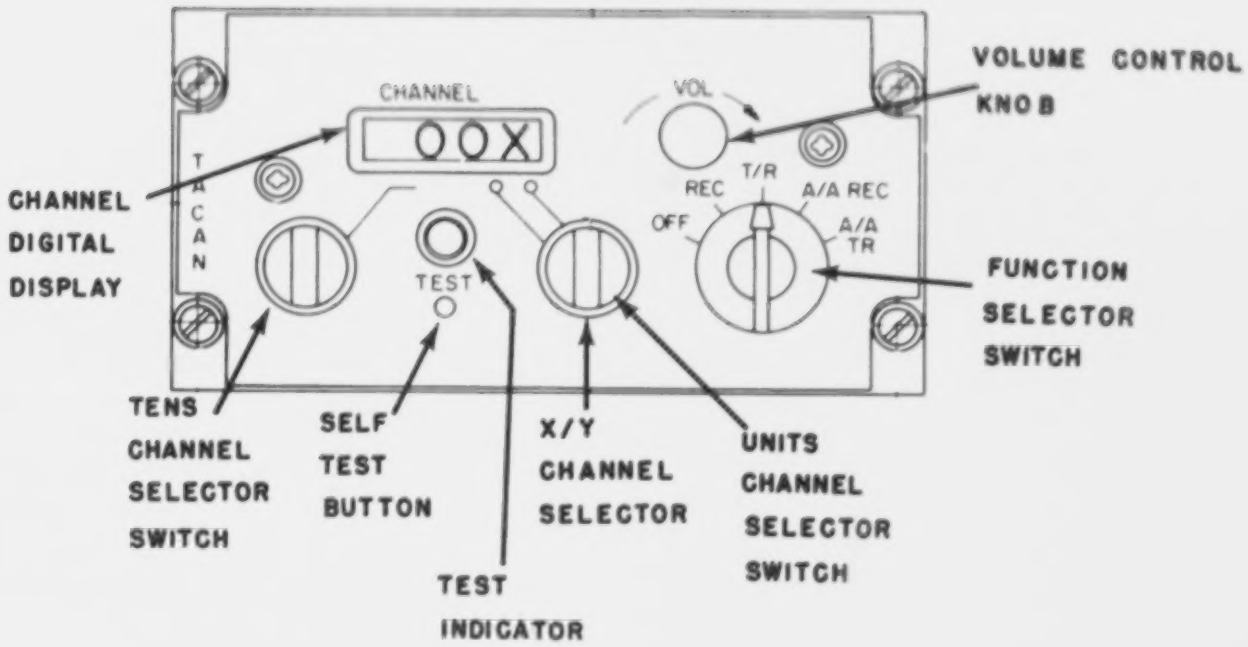


Figure 8-5.

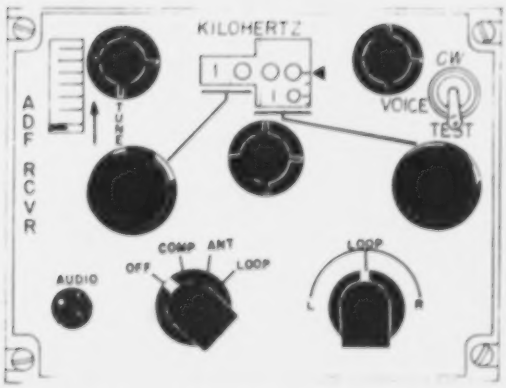


Figure 8-6. - LF/ADF radio AN/ARN-89.

OFF-COMP-ANT-LOOP Switch

The OFF-COMP-ANT-LOOP switch has four positions. In the OFF position, power is removed from the set. The COMP position connects both the loop and sense antennas, and the LF/ADF functions as an ADF. In the ANT position, only the sense antenna is connected, and the LF/ADF functions as a standard low-frequency receiver. In the LOOP position, only the loop antenna is connected, and the LF/ADF may be used for manual direction finding.

CW-VOICE-TEST Switch

The CW-VOICE-TEST switch is a three-position toggle switch, spring loaded away from the TEST position. In the CW position, the receiver's beat frequency oscillator is activated to identify CW signals. In the VOICE position, the receiver functions as a normal AM receiver. In the TEST position, the indicated bearing is automatically slewed to provide a check on ADF operation.

COARSE and FINE Frequency Controls

The COARSE tuning control tunes the receiver in 100-kHz steps as indicated by the first two digits of the kilohertz indicator. The FINE turning control tunes the receiver through 10-kHz marked increments (continuous tuning) as indicated by the last two digits of the kilohertz indicator.

KILOHERTZ Indicator

The kilohertz indicator indicates the operating frequency to which the receiver is tuned.

TUNING Indicator

The tuning indicator indicates relative signal strength while the receiver is being tuned to a specific radio signal.

AUDIO Control

The audio control controls the RF gain of the receiver while the ADF is operating in the ANT or LOOP mode. When the ADF is operating in the COMP mode, the audio control controls the audio output gain.

LOOP L-R Control

The loop L-R control provides for manual positioning of the loop antenna when the ADF is operating in the manual direction-finding mode.

LF/ADF OPERATING PROCEDURES

AM Receiver Mode of Operation

1. Select ADF on the ICS Monitor Selector/ Volume Control.
2. Set the CW-VOICE-TEST switch to the VOICE position.
3. Set the OFF-COMP-ANT-LOOP switch to the ANT position.
4. Adjust the coarse and fine frequency controls to the desired frequency.
5. Adjust the audio control to a comfortable listening level in the headset.
6. Adjust the fine frequency control to obtain a maximum (upward) indication on the tuning indicator.

Compass Mode of Operation

1. Perform the steps of operation for the AM receiver mode of operation.
2. Set the OFF-COMP-ANT-LOOP switch to the COMP position.

NOTE

The # 1 needle on the remote indicator should display the relative bearing of the received ground station in relation to the aircraft.

OPERATING LIMITATIONS AND PRECAUTIONS

The LF/ADF set is subject to the following operating limitations, which are imposed by terrain, weather, and general operating conditions.

Night Effect

At night, radio waves reflected by the ionosphere return to the earth at some point 30 to 60 miles from the station. This night effect may cause the pointer to fluctuate. The effect is most prevalent during the period just before and after sunrise and sunset. Generally, the greater the distance from the station, the greater the effect. The effect can be minimized by averaging the fluctuations, by flying at a higher altitude, or by selecting a lower frequency station. Maximum night effect will be preset with stations operating in frequency ranges above 1,000 kHz. Frequencies below 1,000 kHz are generally less subject to night effect.

Mountain Effect

Bearings taken in the vicinity of mountainous terrain may be erroneous, and the pointer may fluctuate due to magnetic deposits or radio wave reflection.

Shoreline Effect

As radio waves pass from land to water, their direction of travel is changed. Because of shoreline effect, a bearing taken on an inland station from an aircraft over water is inaccurate if the bearing makes an angle of less than 30° with the shoreline. At greater angles, bending is negligible. When taking bearings over water, therefore, choose stations which are either right on the shore, or so located that bearings to them make angles greater than 30° with the shoreline.

General Operating Procedures

Use the following general procedures when operating the LF-ADF set. Only headon bearings are entirely dependable. Keep the helicopter in a level attitude when taking side bearings; accurate bearings cannot be taken with the aircraft in a steep bank, especially when close to a station. For manual direction finding, place the OFF-COMP-ANT-LOOP switch in the LOOP position and slew the LOOP control for an aural null. When you are using the aural null method for taking bearings, the 180° ambiguity must be resolved.

SELF-QUIZ # 8

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When DF-301 equipment is used, the relative bearing to a signal source is read as a continuous magnetic bearing by the _____.

A. No. 2 pointer of the pilot's RMI
B. No. 1 pointer of both pilots' RMIs
C. No. 1 pointer of the copilot's RMI only
D. No. 2 pointer of both pilots' RMIs

2. When homing with the DF-301 on a very strong UHF signal, the DF range switch should be in the _____ position.

A. FORWARD
B. AFT
C. LONG
D. SHORT

3. The LOCALIZER receiver section of the AN/ARN-123 uses _____ of the 200 channels available.

A. 200
B. 160
C. 100
D. 40

4. The navaid selector switch with the marked positions VOR and TAC is located on the _____.

A. instrument panel
B. console control panel
C. VHF/NAV control panel
D. overhead radio control panel

5. The glide slope receiver is a _____ receiver.

A. VHF
B. UHF
C. ADF
D. HF

6. The MARKER BEACON operates on a frequency of _____.

A. 90 Hz
B. 50 KHz
C. 75 MHz
D. 90 MHz

7. The TACAN distance display on the indicator goes up to _____ nautical miles.

A. 126
B. 200
C. 299
D. 390

8. Operation of the air-to-air mode of TACAN requires that the second aircraft have a channel difference of _____ channels.

A. 60
B. 61
C. 63
D. 65

9. Your aircraft should have the Y channels of the AN/ARN-118 selected when _____.

A. using A/A with an aircraft using X channels
B. navigating on ground stations
C. all X channels are inoperative
D. using A/A with an aircraft using Y channels

10. The frequency range of the AN/ARN-89 LF ADF is _____.

A. 100 to 1,000 KHz
B. 100 to 2,000 KHz
C. 100 to 3,000 KHz
D. 100 to 4,000 KHz

11. The FINE tuning control tunes the LF ADF receiver through _____ marked increments.

A. 5 KHz
B. 10 KHz
C. 15 KHz
D. 20 KHz

ANSWERS TO SELF-QUIZ # 8

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	8-1
2	D	8-1
3	D	8-4
4	A	8-3
5	B	8-4
6	C	8-4
7	C	8-6
8	C	8-6
9	D	8-6
10	C	8-7
11	B	8-8

HH-3F LORAN C NAVIGATOR

Reading Assignment:
Pages 9-1 through 9-18.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

Explain the operation and leading particulars of the AN/ARN-133 LORAN C NAVIGATOR.

LORAN C NAVIGATOR AN/ARN-133

The AN/ARN-133 LORAN Navigator is a microcomputerized LORAN-C and D navigator capable of providing continuous navigation information anywhere LORAN C or D coverage exists. LORAN signals are received via the antenna located overhead the cockpit, sent to the antenna coupler in the forward electronics compartment and then processed by the navigator located on the copilot's side of the center console. Automatic initialization procedures commence when the MODE switch is turned to initialize. The Navigator is protected by a circuit breaker on the copilot's overhead circuit breaker panel under the general heading DC PRI and marked LORAN C.

CONTROLS, INDICATORS, AND DISPLAYS

The Navigator front panel is divided into five groups: displays, switches and indicators, keyboard, DISPLAY switch and MODE switch. Figures 9-1 through 9-2 illustrate each of these groups.

General Keyboard Information

The keyboard is used to enter information into the navigator. The circular and rectangular keys have essentially a single function, while the square keys have dual functions. The normal entry sequence consists of a clear, function, number, and insert. Specific entry sequences for all navigator functions are discussed in the following pages. Some special keyboard features are:

1. Any entry sequence may be terminated prior to the final INSERT by depressing CLR. This returns the displays to the original condition.

2. After the final INSERT, the only way to change entered data is to perform the entire procedure again, replacing incorrect data with the correct.

3. To correct an error in a number entry as it is made, depress the LEG CHG key, which backs out the last-entered digit from the display. Successive depressions of the LEG CHG key continue to back out successive digits.

Mode Switch

The five position rotor MODE switch has built-in detents protecting the INITIALIZE and EMERG positions. One is between INITIALIZE and OPERATE, and the other between ADVISE and EMERG. To cross either of these detents, push the knob into the panel and turn. These detents prevent inadvertent movement to the INITIALIZE and EMERG positions, thereby losing track of LORAN signals. Switch positions are as follows:

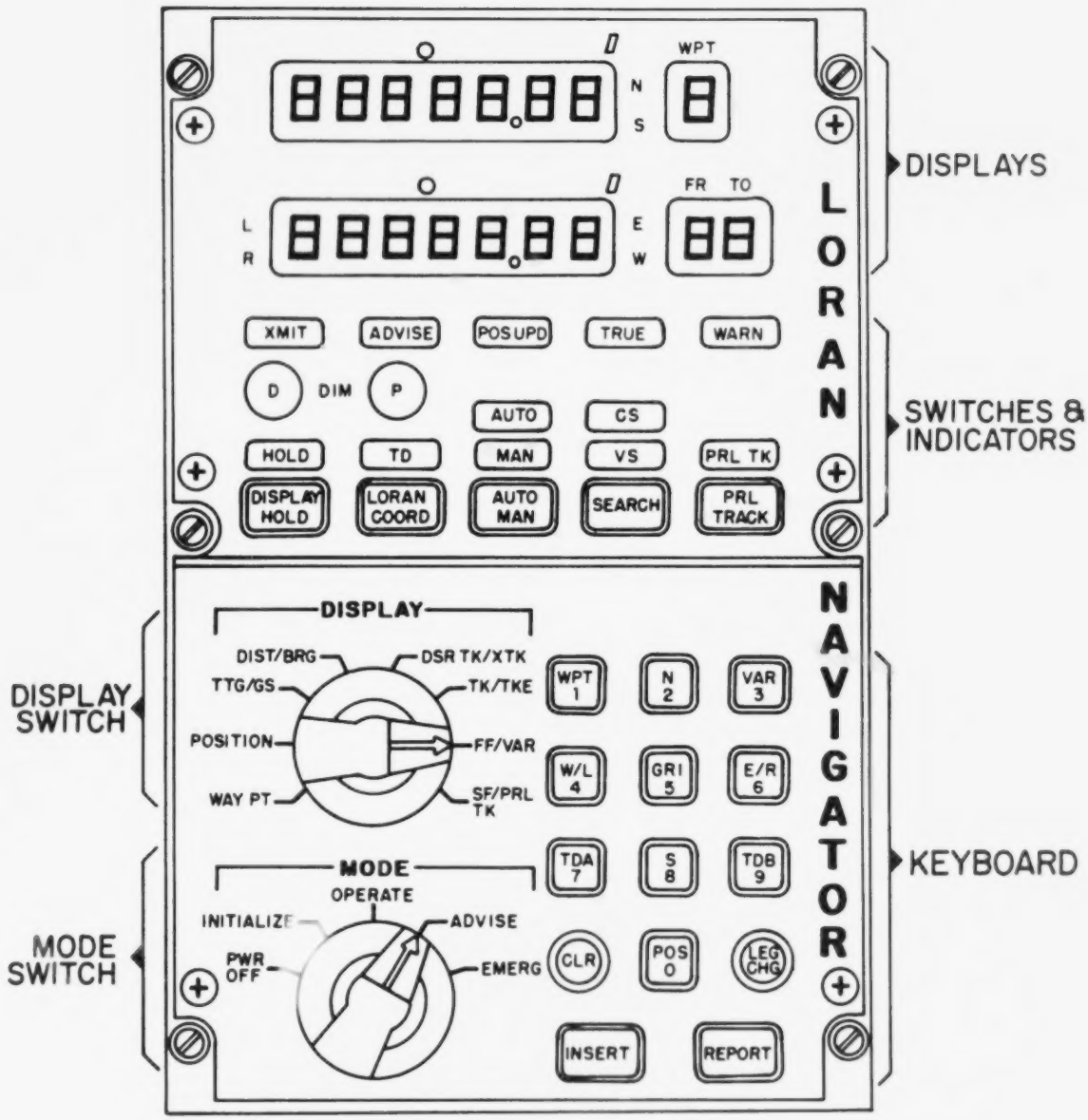
1. PWR OFF - Removes all external system power.

CAUTION

During engine start or other conditions that may produce DC power fluctuations, the MODE switch should be in the PWR OFF-position. In case of extreme fluctuation; i.e., shipboard power starts, the LORAN-C circuit breaker should be pulled.

2. INITIALIZE - Allows all initial data to be entered.

(Detent) The LORAN receiver is held in search.



SWITCHES ARE SHOWN IN LAMP TEST POSITION.
ALL INDICATORS AND DISPLAY SEGMENTS, EXCEPT
XMIT, ARE ILLUMINATED.

Figure 9-1. - AN/ARN-133 Front Panel.

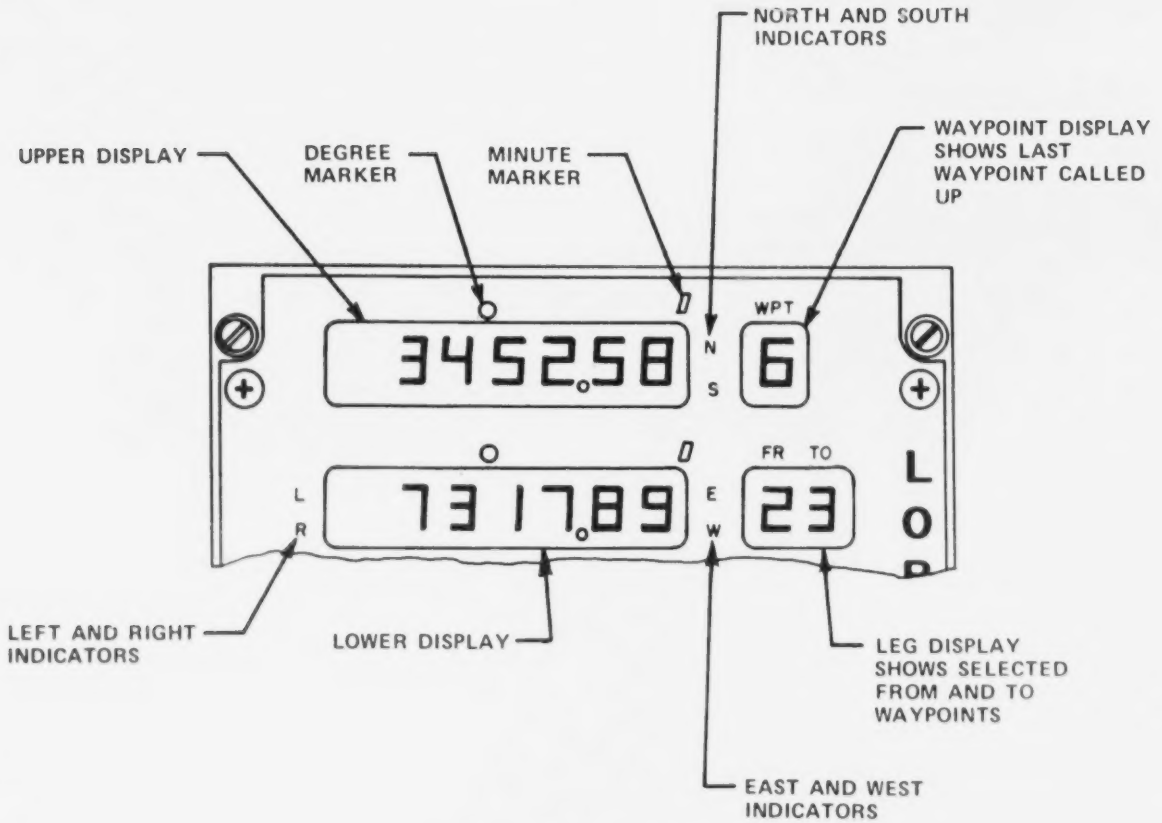


Figure 9-2. - Displays.

NOTE

When turning the navigator on, care should be taken to pause momentarily in the INITIALIZE position. Failure to pause in this position will result in non-retrieval of the stored chain and positional data, and possible freeze-up of the navigator.

3. OPERATE - This is the normal operating mode. The receiver is freed to acquire and track signals, and the navigation function and displays are activated.

4. ADVISE (Detent) - Used to determine why ADVISE and WARN indicators are illuminated or flashing. Also used in conjunction with DISPLAY switch positions to provide signal and system status and analysis. Allows some pilot control over receiver functions.

5. EMERG - Transmits aircraft position via data link with emergency report code(7) included. The EMERG position is not used in this installation.

Display Switch

The eight position rotary DISPLAY switch (figure 9-1) allows information to be entered or displayed with the MODE switch in the OPERATE position as follows:

NOTE

The positions have different functions with the MODE switch in the ADVISE position. Refer to ADVISE and WARN functions section.

1. WAY PT - Allows entry or display of selected waypoint coordinates in lat/long or time differences (TDA and TDB) in the upper and lower displays respectively for any selected waypoint appearing in the WPT display.

2. POSITION - Allows present POSITION display and entry in lat/long or time differences (TDA and TDB) in the upper and lower displays respectively. The navigator continuously computes POSITION during the display hold, and when the display is released, shows correct present POSITION.

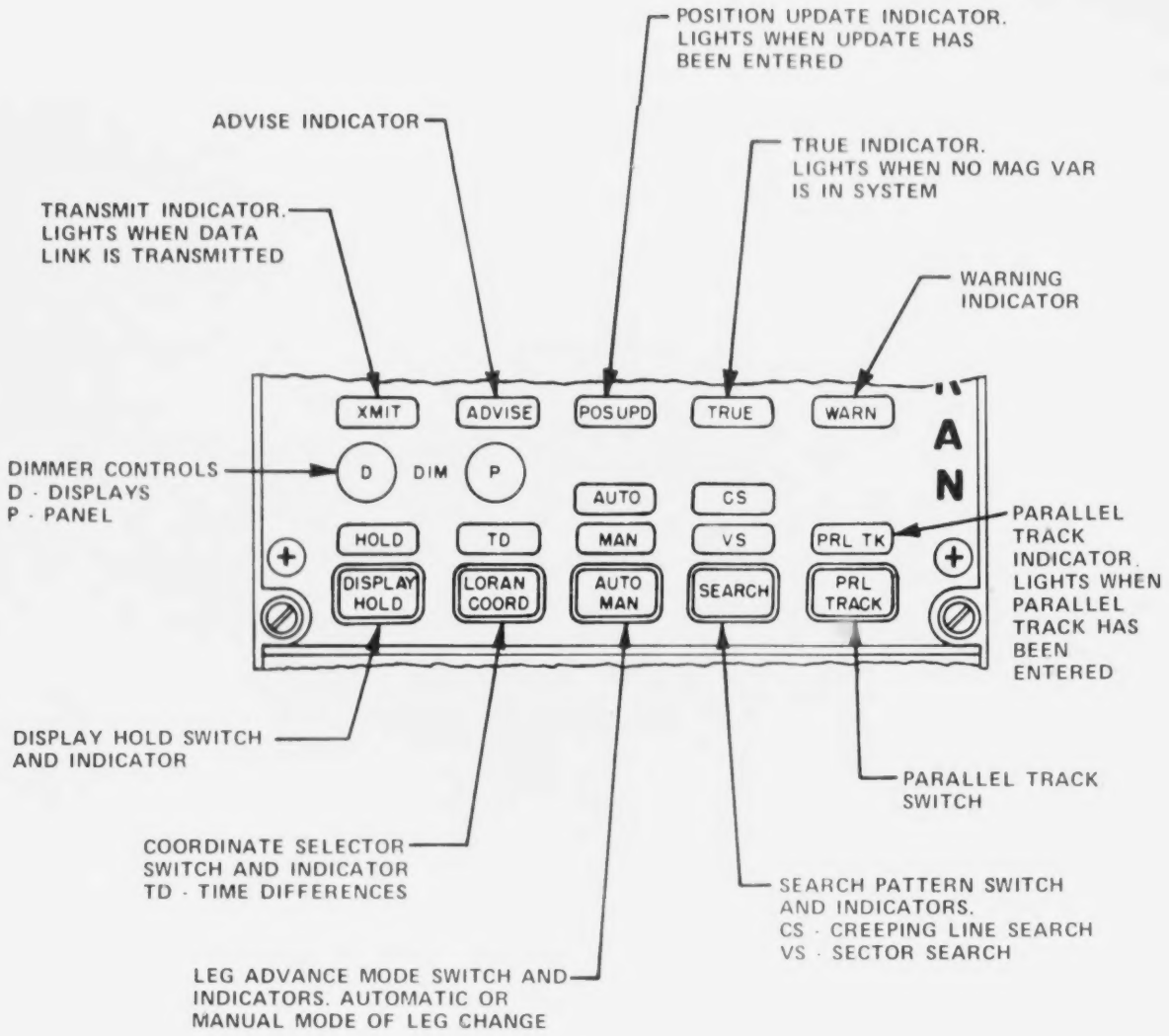


Figure 9-3. - Switches and Indicators.

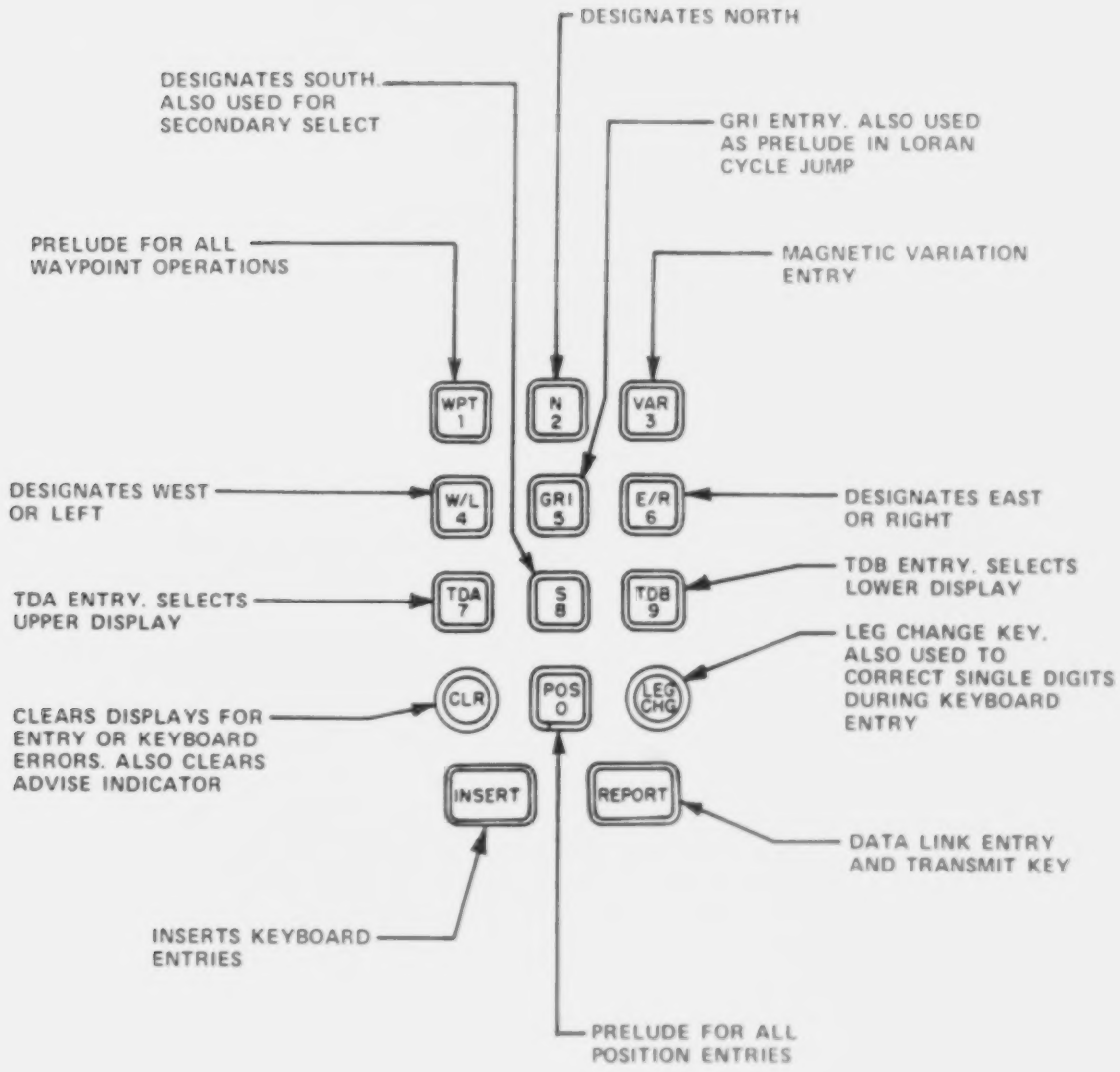


Figure 9-4. - Keyboard.

3. TTG/GS - Presents time to go (TTG) from present position to the TO waypoint in the upper display and ground speed (GS) in the lower display. Time to go is blanked when ground speed is 9 knots or less.

4. DIST/BRG - Presents range (DIST)) to the selected TO waypoint in the upper display. Bearing angle (BRG) to the TO waypoint appears in the lower display and is with respect to north (true north if no magnetic variation has been entered). When the interwaypoint range and bearing procedure is used, the following information is displayed:

a. Upper Display - Distance between waypoints.

b. Lower Display, Left Side - Bearing on the requested leg.

c. Lower Display, Right Side - FROM and TO waypoints requested.

This information is presented for ten seconds after which the display reverts back to normal.

5. DSR TK/XTK - Presents the desired track angle (DSR TK) to the nearest degree in the upper display with respect to the selected waypoints. Crosstrack distance (XTK), either left or right, is measured to hundredths of a nautical mile and shown in the lower display.

6. TK/TKE - Presents track angle (TK) with respect to north (true north if no magnetic variation has been entered) in the upper display and track angle error (TKE) in the lower display. Illumination of the R or L indicates present track angle error is to the right or left of the desired track angle. Display of these functions is blanked below 10 knots.

7. FF/VAR - Presents data link information for flight following (FF) consisting of the aircraft identification number (preset by technician prior to flight) from 00 to 99 presented in the upper left display and the single digit report code in the upper right. Entered magnetic variation (VAR) in degrees EAST or WEST appears in the lower display.

8. SF/PRL TK - Presents data associated with CS or VS search patterns (Special Function) in the upper display. The associated information cue letter appears in the WPT display. In the lower display parallel track offset distance (PRL TK) is presented to tenths of a nautical mile either right (R) or left (L) of course.

Advise and Warn Functions

The ADVISE and WARN indicators may be illuminated by any of the following conditions. To determine the cause of ADVISE and WARN indications, set the MODE switch to ADVISE and the DISPLAY switch to DSR TK/XTK. A "1" appearing in any digit position in the upper or lower display signifies the condition listed in figure 9-5.

NOTE

More than one cause may be indicated for any given ADVISE or WARN.

Advise Indications

The ADVISE indicator illuminates or flashes and the corresponding display digit is set to "1" when any of the following conditions occur:

1. MISSED WAYPOINT ARRIVE - The navigator continually monitors the distance-to-go to the selected waypoint. If this changes from a decreasing to an increasing value and the arrival

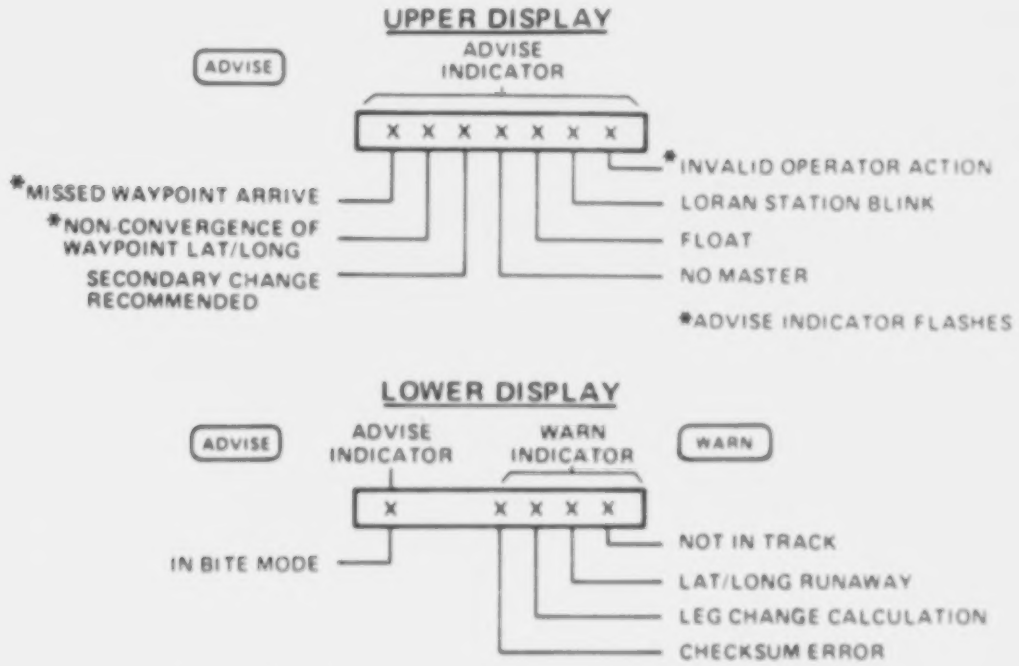


Figure 9-5. - Interpretation of ADVISE and WARN indications.

criteria were not met, signifying a missed-waypoint condition. ADVISE flashes to allow manual selection of the NEXT leg.

2. NON-CONVERGENCY OF WAYPOINT LAT/LOG - ADVISE flashes when the navigator tries to perform a lat/long conversion of a waypoint entered in time differences but cannot due to signals being out of range, poor station geometry, etc.

3. SECONDARY CHANGE RECOMMENDED - ADVISE illuminates when the secondary pair in use is not the secondary pair recommended by the navigator. The navigator compares the signal to noise ratios and relative positions of the LORAN secondaries and recommends the best pair selection that results in the smallest navigation error.

Stations not currently being tracked and stations less than 38 miles from the receiver are not considered. This function is inoperative during master independent operation. Use the automatic secondary advisory function to determine which is the recommended pair.

4. INVALID OPERATOR ACTION - The following erroneous actions may illuminate the ADVISE indicator; incorrect switch/key combinations; certain incorrect values, invalid GRI (one not stored in memory) and certain invalid input coordinate values.

5. LORAN STATION BLINK - ADVISE illuminates when one of the selected LORAN secondary stations blinks. The LORAN control station causes the LORAN signal to blink whenever the time delay is not within tolerance. During blink, portions of the LORAN signal are alternately turned on and off. Blinking stations should not be used.

6. FLOAT - ADVISE illuminates if any signal in use (master, A, or B) goes into float. Float mode indicates that the signal has been lost and the navigator is temporarily dead reckoning using last-known velocity and direction.

7. NO MASTER - 1 = System does not have the real master.
0 = System has the real master.
8 = Master independence has been overridden (inoperative).

8. IN BITE MODE - ADVISE illuminates when the navigator is operating on the Built In Test Equipment (BITE) chain of 5100.

Warn Indicators

WARNING

Whenever the WARN indicator is illuminated, regardless of cause, do not use the sytem for navigation.

The WARN indicator illuminates and the corresponding lower display digit is set to "1" when any of the following conditions occur:

1. NOT IN TRACK - WARN illuminates when any of the three signals being used is not in track. The WARN indicator stays on for 20 seconds after the navigator goes back into track to allow the TDs to stabilize.

2. LAT/LONG RUNAWAY - The navigator continually monitors the rate of change of lat/long and checks it for reasonableness. If the rate of change is unreasonable or excessive, WARN illuminates.

3. LEG CHANGE CALCULATION - When marking an automatic or manual leg change, the navigator calculates new navigation data. During this brief calculation period, the navigator illuminates the WARN indicator, advising that data is unreliable.

4. CHECKSUM ERROR - WARN illuminates if the navigator has failed self test (checksum). This usually indicates hardware failure.

Advise Functions

The ADVISE position of the MODE switch also provides a readout and navigator status and is used in conjunction with other DISPLAY switch positions to check on a number of system parameters and other data. The data in each of the eight DISPLAY switch positions is listed and described in figure 9-6.

PREFLIGHT PROCEDURES

The preflight procedures depend on whether the aircraft will be flying in the same or different area as before, and whether maintenance action has erased initialization data. When power is applied, the navigator is automatically initialized to the last-computed present position, last-entered LORAN chain, magnetic variation, waypoints, and other previously entered data. This data is held in temporary memory when power is removed from the navigator. When flying in the same general area and temporary memory is intact, set the MODE switch to OPERATE, pausing momentarily in initilize.

Display Switch Position	Function	Upper and Lower Display Data
WAY PT	TD1	X X X X X X X Microseconds
	TD2	X X X X X X X Microseconds
POSITION	TD3	X X X X X X X Microseconds
	TD4	X X X X X X X Microseconds
TTG/GS	Velocity	Master Oscillator X X X – X X X
	Envelope Counter	M 1 2 X X – X X X X
DIST/BRG	Loran Status	M 1 2 3 4 X X X X X – – 0 – Search 4 – Fine env 2 1 – Coarse env 7 – Track 2 – Coarse env 8 – Float 3 – Fine env 1
	SNR	M 1 2 3 4 X X X X X – X Secondary number of designated master (master independent operation). Normal operation (real master) = 0 Master independent = 1 - 4 Poor SNR 0 – 0 - 19 1 – 20 - 29 2 – 30 - 39 3 – 40 - 49 Fair SNR 4 – 50 - 59 5 – 60 - 69 6 – 70 - 79 Good SNR 7 – 80 - 89 8 – 90 - 99 9 – Equal to or greater than 100

Display Switch Position	Function	Upper and Lower Display Data	
DSR TK/XTK	Interpretation of ADVISE and WARN	See previous two pages for complete breakdown of ADVISE and WARN indications.	
TK/TKE	GRI (Normal entry)	X X X X – – –	
	GRI (Manual chain entry)	X X X X X X X	
	Secondaries	Recommended X X – – – X X In Use	
FF/VAR	Lamp Test	WPT N S FR TO E W	
SF/PRL TK	Memory Address	– – X X X X X (octal)	This function reads TDY-52B computer RAM and ROM memories.
	Memory Data	– X X X X X X (octal)	

Figure 9-6. - Advise Functions.

9-8

NOTE

When turning the navigator on, pause momentarily in the INITIALIZE position. Failure to pause in this position will result in non-retrieval of stored chain and positional data, and possible freeze-up of the navigator.

If complete reinitialization is necessary after maintenance of transfer to a different LORAN coverage area, perform the following first:

1. Self test (BITE).

NOTE

Self test (BITE) should be accomplished any time a problem is suspected in the system. After self test is used it will be necessary to enter desired chain GRI, secondary pair, and present position, since these are changed in the test.

2. Initial present position entry.

3. Loran chain GRI selection.

4. Secondary pair selection.

This is the minimum information required to go into OPERATE, enabling the navigator to function. Enter the following, as applicable, in any sequence:

1. Waypoints in lat/long or TD's.

2. Magnetic variation.

3. FROM-TO selection for initial leg.

Self Test (BITE)

NOTE

Self test requires going into INITIALIZE mode, which terminates all nav functions and loss of signal track.

Self test exercises all primary functions of the navigator less the antenna, antenna coupler, and associated cabling. It uses an internally simulated LORAN signal, and is initiated in the same manner as selecting a new GRI, using a pseudo chain rate of 51,000 microseconds.

1. Perform lamp test by setting MODE switch to ADVISE and DISPLAY switch to FF/VAR. All displays and indicators except XMIT should illuminate.

2. MODE switch to INITIALIZE and DISPLAY to TK/TKE. Depress LORAN COORD switch to illuminate the TD indicator.

3. Adjust dim knobs as required. Panel lighting indicators and displays should vary accordingly.

4. Depress CLR key. Displays should blank.

5. Depress GRI key.

6. Insert 5100 into keyboard. Number should appear in lower display.

7. Depress INSERT. 5100 should jump to the upper display. ADVISE indicator should illuminate, indicating BITE mode is enabled. WARN indicator should illuminate. Secondaries 1 and 2 are automatically selected and the initial present position of 24°N, 164°W is automatically entered.

8. Set MODE switch to OPERATE and DISPLAY switch to POSITION. The navigator should now search and settle on the simulated chain. When the WARN indicator goes out, the displayed time differences should be: TDA = 16000.00 ± 0.2 in the upper display, TDB 36000.00 ± 0.2 in the lower.

9. Depress LORAN COORD switch to extinguish the TD indicator. Displayed lat/long should be N 23° 52.82′ ± 0.05 in the upper display and W 164° 22.04′ ± 0.05 in the lower. Self test is satisfactory if time differences in step 8 and lat/long in this step are as indicated.

10. To terminate self test, set MODE switch to INITIALIZE and enter initial present positions and desired GRI and secondaries.

Initial Present Position Entry

Since two geographic positions are defined by any pair of LORAN-C time delays, the navigator must have an initial estimate of present position. Enter present position as accurately as it is known.

NOTE

Initial present position must be entered in lat/long.

Present position entry is not always required since the last known position is stored at shutdown. Use the following procedure to enter initial present position. To change only one coordinate, omit steps 3, 4, 5 and 6 or 3, 7, 8 and 9 as applicable.

1. MODE switch to INITIALIZE and DISPLAY to POSITION.

2. Depress CLR key. Displays should blank.

3. Depress POS key.

4. Depress N or S latitude key. Appropriate indicator should illuminate.

5. Enter into the keyboard the latitude, using zeros (0) as required. Number should appear in upper display.

6. Depress INSERT.

7. Depress E or W longitude key. Appropriate indicator should illuminate.

8. Enter into keyboard the longitude. Enter zeros (0) as required. Number should appear in lower display.

9. Depress INSERT. Displays should return to normal.

GRI SELECTION

This time that elapses between the initating pulse from the master and the next initiating pulse from the same master is known as the group repetition interval (GRI).

The following procedure is used to select a LORAN chain GRI. When changing a LORAN chain GRI during flight, allow time for the navigator to acquire and track the new signals (WARN indicator extinguished). Any GRI's not listed in figure 9-7 must first be stored using the manual chain storage procedure.

Chain Rates			Secondaries			
			1	2	3	4
Central European	3970	(L3)	X	Y		
Central Pacific	4990	(S1)	X	Y		
Canadian East Coast	5930	(SH7)	X	Y	Z	
Canadian West Coast	5990	(SH1)	X	Y	Z	
North Atlantic	7930	(SL7)	W	X	Z	
Gulf of Alaska	7960	(SL4)	X	Y		
Norwegian Sea	7970	(SL3)	X	W	Y	Z
Southeast U. S.	7980	(SL2)	W	X	Y	Z
Mediterranean Sea	7990	(SL1)	X	Y	Z	
Great Lakes	8970	—	W	X	Y	
U. S. West Coast	9940	(SS6)	W	X	Y	
Northeast U. S.	9960	(SS4)	W	X	Y	Z
Northwest Pacific	9970	(SS3)	W	X	Y	Z
North Pacific	9990	(SSI)	X	Y	Z	

Figure 9-7. - Secondary Pair Identification Scheme.

1. MODE switch to INITIALIZE and DISPLAY switch to TK/TKE.

2. Depress CLR key. Displays should blank.

3. Depress GRI key to activate GRI function.

4. Enter desired chain rate (four most significant digits) into keyboard. Number should appear in lower display.

NOTE

If manually stored chain is to be selected enter the same seven digit number stored in Step 1 of the manual chain storage procedure.

5. Depress INSERT. GRI should jump to upper display. If selected GRI is not stored in permanent memory or programmed in temporary memory, the ADVISE indicator will flash. Depress CLR key to remove keyboard error ADVISE light and then reenter correct GRI.

Secondary Pair Selection

Secondary pair selection may be made in either INITIALIZE or ADVISE modes. Current LORAN chain GRI and secondary pair are normally stored in temporary memory. Making a secondary selection in ADVISE mode may be done without signal loss which would occur if INITIALIZE is selected when making the change. Use the ADVISE position for in-flight changes. When a secondary pair change is made in flight, the TD readout will jump to the new values.

NOTE

Repeated attempts at selection of a poor secondary pair will result in a navigator freeze-up. No more than two attempts should be made at selection of a secondary pair that the navigator initially refuses.

Use the following procedure to select a secondary pair.

1. Set MODE switch to INITIALIZE if selection is to be made during initialization; set to ADVISE if selection is to be made in flight. Set DISPLAY switch to TK/TKE.

2. Depress CLR key. Displays should blank.

3. Depress S key for secondary select.

4. Enter the two-digit number repesenting secondary pair desired as shown in figure 9-6. For example, to use the X and Y secondaries of the 9960 chain, enter 23. Entered number should appear in lower display.

5. Depress INSERT. Newly selected secondary pair should appear in right-most two digits of lower display; recommended pair should appear in left-most two digits. GRI should appear in the upper display. If the selected secondary pair does not match the secondaries available in the selected chain, the ADVISE indicator will illuminate. Check secondary number and reenter.

Automatic Secondary Pair Advisory

Once a LORAN chain GRI and secondary pair have been selected the navigator automatically acquires and tracks all receivable secondaries (up to four). The navigator continually determines the optimum secondary pair to be used and the ADVISE indicator illuminates each time a change is recommended. The operator may enter the recommended secondary pair, ignore it and clear the ADVISE by depressing CLR, or enter another choice. To determine the navigator's recommendation for optimum secondary pair:

1. Set MODE switch to ADVISE and DISPLAY switch to TK/TKE. Upper display should show selected GRI. The two left-most digits in the lower display show the recommended secondary pair; the two right-most digits show the secondary pair actually in use according to figure 9-7.

WAYPOINT NAVIGATION

A waypoint is a numbered position to be used in navigating or any point for which navigational data is desired. Waypoint numbers appear in two locations on the front panel; the WPT display and the FR TO (leg) display. Control of the WPT display is by the WPT key and the FR TO display is by the LEG CHG key. Use the WPT key and display to enter or display a single waypoint. Use the LEG CHG key and FR TO display to initiate the AUTO navigation sequence or to manually specify a new leg. The number appearing in the waypoint is automatically set to 1 at power-on.

NOTE

Prior to commencing a leg change, allow the navigator to settle after initial lock-on. Correct (± 10 knots) ground speed is indicative that settling has

occurred. Failure to allow the equipment to stabilize, prior to assigning it a navigation task, will result in non-convergence, possible lat/long runaway and memory saturation accompanied by loss of track and/or navigator freeze-up.

A maximum of nine waypoints in either lat/long or time differences may be entered. When calling up a FROM and TO leg enter the number of the two desired waypoints. Navigational data with respect to a course is defined by those two points. If a 0 and a TO waypoint are called up, navigational data will be from the aircraft present position at the time the INSERT key is pressed to the selected TO point. The 0 tells the navigator that information from present position is desired (figure 9-8).

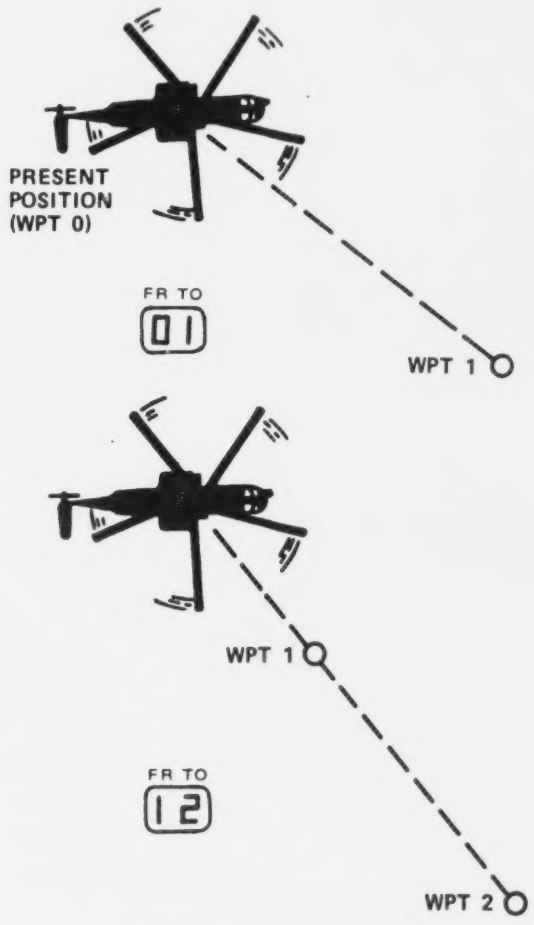


Figure 9-8. - Waypoint Navigation.

The waypoints entered are stored in memory. To clear a waypoint enter a new set of coordinates over the old.

Auto/Manual Leg Chg Selection

The AN/ARN-133 permits automatic or manual LEG CHG selection. In MAN mode, the operator makes the selection. The operator must call up one leg at a time. Navigation with respect to that leg will continue until a new leg change is completed, even if arriving at or passing the desired waypoint. In AUTO mode, the navigator sequences legs automatically, selecting the next leg in numerical sequence each time arrival at a waypoint is completed. If leg changes are entered where the TO waypoint number is greater than the FROM number, the advance of legs, in either AUTO or MAN, will increment: 12, 23, 34, 45, 56, 67, 78, 89. When the limit, 89, is reached, the next leg will be 91; then back to 12, 23, 34, etc. If leg changes are entered where the FROM waypoint number is greater than the TO, the sequence of legs will decrement: 65, 54, 43, 32, 21. When the limit, 21, is reached, the next leg will be 19; then 98, etc. To manually activate a leg change, press CLEAR, LEG CHG, INSERT.

EXAMPLE:

If the navigator is initialized by entering lat/longs for seven consecutive waypoints, when ready for takeoff, set the MODE switch to OPERATE and select AUTO. The AUTO indicator illuminates and the operator calls up the first leg. The navigator must see an initial LEG CHG entry before it will call up the waypoint table, even in AUTO mode. Use the sequence shown in figure 9-9 to call up the first leg.

Subsequent leg changes are automatic. Navigation information is provided from present position (0) to waypoint 1. Arriving over 1, the navigator will automatically switch to leg 12, giving navigation information from 1 to 2. When arriving over 2, the navigator switches to leg 23, etc. If in AUTO, manual leg changes may still be accomplished to manually increment to the next leg by depressing CLR, LEG CNG, INSERT.

When arriving at the TO waypoint, the next waypoint in numerical sequence will be used. If FR TO leg change (flashing ADVISE indicator) is missed, it is not necessary to fly back over the waypoint to enable the navigator to acquire it. Manually select the next leg using the above procedure. If the coordinates of the current TO waypoint are changed, the navigator will automatically calculate data for the new position.

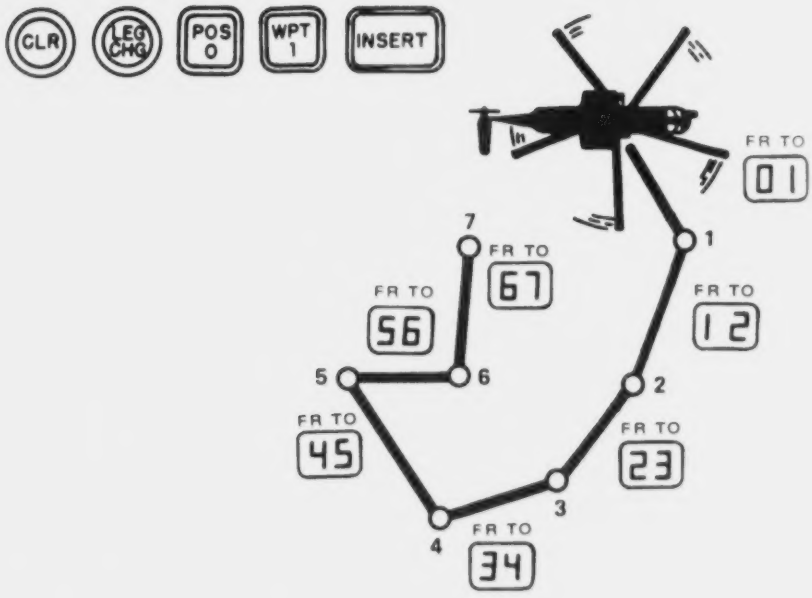


Figure 9-9. - Waypoint Selection.

Waypoint Call Up

Use the following procedure to call up any waypoint for display, entry, or modification. The last waypoint called up appears in the WPT display in most DISPLAY switch positions.

1. Set MODE switch to INITIALIZE or OPERATE and DISPLAY switch to WAY PT. Previously stored coordinates of the waypoint appearing in WPT display, if any, should appear in upper and lower displays.

2. Depress CLR key. Displays should blank.

3. Depress WPT key.

4. Enter single digit into keyboard (1-9) of desired waypoint. Number should appear in lower display.

5. Depress INSERT. Entered number should jump to WPT display. Previously stored coordinates, if any, should appear in upper and lower displays.

Waypoint Entry In Time Differences

Time differences are directly relatable to position for a specified LORAN chain. Although lat/long is used as the primary reference system, waypoints may be entered in TD's.

EXAMPLE:

If a report of a target at a certain TD fix is received without regard to lat/long, enter those TDs as a waypoint, then enter a leg change of 01. Navigation from present position (0) to that fix (1) is provided. See figure 9-10.

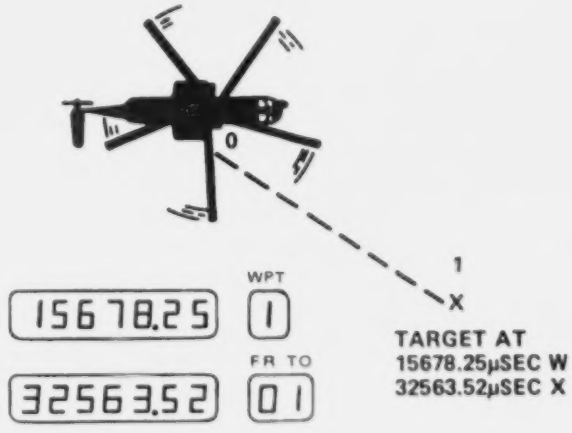


Figure 9-10. - Waypoint Entry in Time Differences.

NOTE

TD's are not related to a geodetic frame of reference, but only relate to the chain from which they were derived. The navigator must be operating on that chain, using those secondaries. When waypoints are entered in TDs depending on distance and geometry, the navigator may not be able to do an ambiguous lat/long conversion until closer to the fix.

Use the following procedure to entry waypoints in time differences. To change only one coordinate, omit steps 4, 5 and 6 or 4, 7 and 8, as applicable.

1. Call up the desired waypoint number using the waypoint call up procedure.

2. Depress LORAN COORD switch to illuminate TD indicator.

3. Depress CLR key. Displays should blank.

4. Depress POS key.

5. Depress TDA key and enter into keyboard the seven digit time difference for TDA to hundredths of a microsecond. The new TDA should appear in upper display.

6. Depress INSERT. New TDA momentarily flashes.

7. Depress TDB key and enter into keyboard the seven digit time difference for TDB to hundredths of a microsecond. The new TDB should appear in lower display.

8. Depress INSERT. New coordinates should remain in upper and lower displays.

9. Repeat steps 1 through 8 for each of the remaining waypoints to be entered. Successive depressions of INSERT will increment the WPT display to the desired waypoint number.

Waypoint Entry In Lat/Long

Use the following procedure to enter waypoints in lat/long. To change only one coordinate, omit steps 4, 5, 6 and 7 or 4, 8, 9 and 10, as applicable.

1. Call up the desired waypoint number using the waypoint call up procedure.

2. Depress LORAN COORD switch to extinguish TD indicator.

3. Depress CLR key. Displays should blank.

4. Depress POS key.

5. Depress N or S latitude key. Appropriate indicator should illuminate.

6. Enter the latitude from keyboard. Number should appear in upper display.

7. Depress INSERT.

8. Depress E or W longitude key. Appropriate indicator should illuminate.

9. Enter the longitude from keyboard. Number should appear in lower display.

10. Depress INSERT. New coordinates should remain in upper and lower displays.

11. Repeat steps 1 through 10 for each of the remaining waypoints to be entered. Successive depressions of INSERT will increment the WPT display to the desired waypoint number.

REPORT CODE ENTRY

NOTE

Although the report code entry procedures may be accomplished, compatible ground/ship equipment must be available to permit use.

Use the following procedure when a data link report code number is to be selected or changed.

1. MODE switch to OPERATE.

2. Depress CLR key. Displays should blank.

3. Depress REPORT key.

4. Enter into keyboard the desired report code number. (Any digit from 1 through 6 for manual reporting and any digit from 01 through 06 for automatic.) Number should appear in lower display.

5. Depress INSERT. Displays should return to selected function.

6. To set the report code to 0 (which turns on automatic reporting of present position), depress CLR, REPORT, and INSERT.

SEARCH PATTERNS

Two search patterns may be stored in the Navigator: one creeping line (CS) and one sector (VS). Either of these may be called up using the SEARCH function to obtain navigational data to execute the pattern. Once the search patterns are stored, various parameters of either pattern may be individually changed. Search patterns are entered by following cue letters appearing in the WPT display.

Creeping Line Search (CS)

Commence Search Point (CSP) is located one-half search track spacing inside the corner of the search area. Leg length is search area width minus one track spacing (figure 9-11).

Sector Search (VS)

Commence Search Point (CSP) is at datum. Leg length is equal to circle radius. Track spacing is measured at the half-radius point. No entry is made for pattern length (figure 9-12).

Search Pattern Entry

Use this procedure to enter a CS or VS search pattern. Letters A through E appear in the WPT display, cuing the type of data to be entered next. By depressing INSERT a second time at the end of any sequence, the next step (A through E) may be left with data unchanged from a previous entry.

1. Set MODE switch to OPERATE and DISPLAY switch to SF/PRL TK. Lower display should show previous parallel track offset, if any.

2. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH pushbutton again for VS indicator to illuminate. Cue letter A should appear in WPT display. Previously selected waypoint used for CSP, if any, should appear in upper display.

Enter Commence Search Waypoint

1. Depress CLR key. Display should blank.

2. Enter into keyboard Commence Search Point waypoint number. This number should appear in lower display.

3. Depress INSERT. Cue letter b should appear in WPT display. Last entered leg length, if any, should appear in upper display.

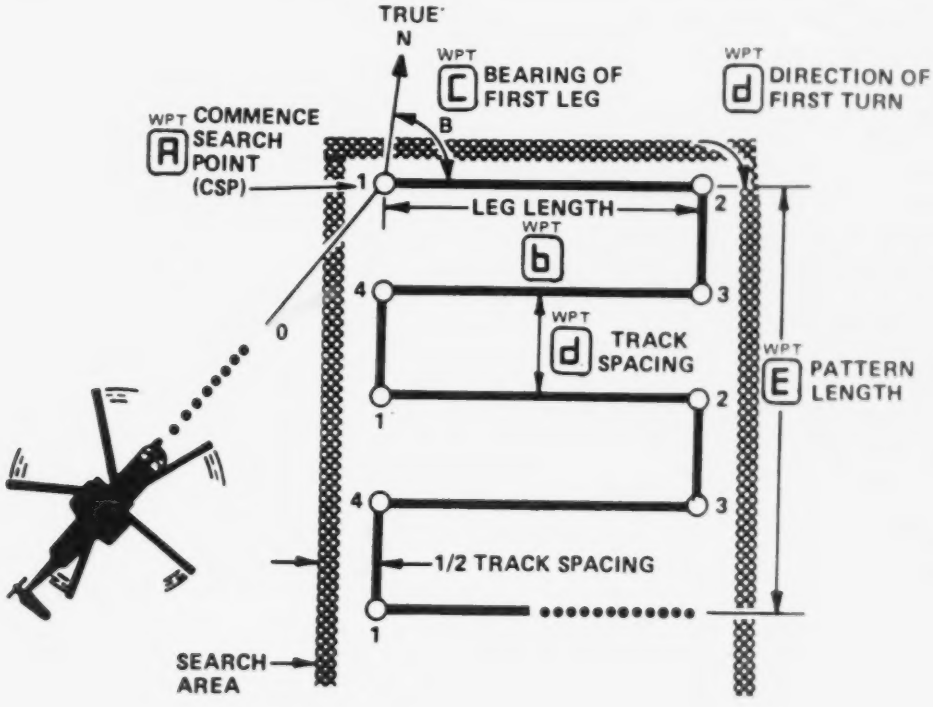


Figure 9-11. - Creeping line search.

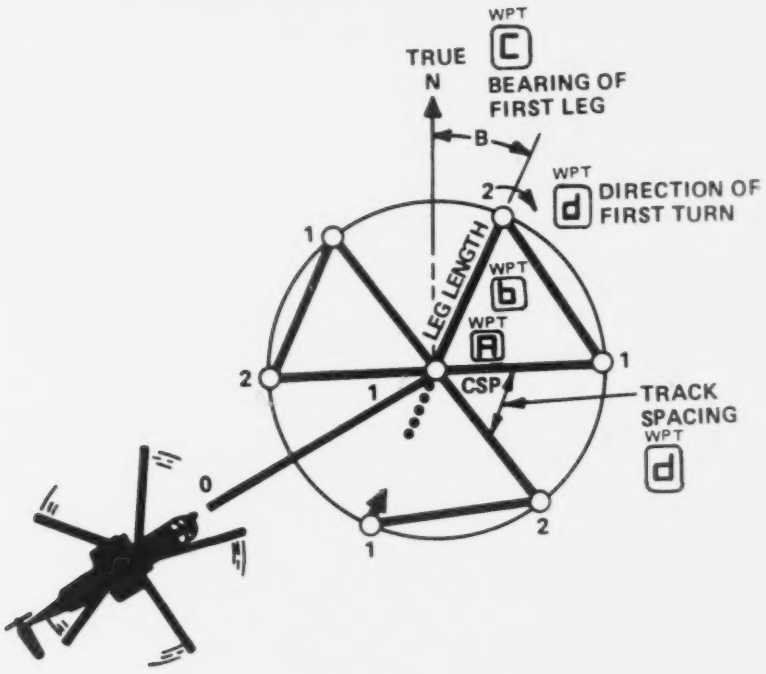


Figure 9-12. - Sector Search.

Enter Leg Length

1. Depress CLR key. Displays should blank.

2. Enter length of search leg in nautical miles and tenths (0.1-99.9). For VS patterns, this is the circle radius. This number should appear in lower display.

3. Depress INSERT. Cue letter C should appear in WPT display. Last entered bearing for first leg should appear in upper display.

Enter Bearing of First Leg

1. Depress CLR key. Displays should blank.

2. Enter into keyboard bearing of first leg in degrees. This number should appear in lower display.

3. Depress INSERT. Cue letter d should appear in WPT display. Last entered direction of first turn should be indicated on L or R indicator. Last entered track spacing should appear in upper display.

Enter Direction of First Turn and Track Spacing

1. Depress CLR key. Displays should blank.

2. Depress L or R key to select left or right direction of first turn. Appropriate L or R indicator should illuminate.

3. Enter desired track spacing into keyboard (0.1-99.9). For VS patterns, this is measured at the half-radius points. This number should appear in lower display.

4. Depress INSERT. R or L indicator should extinguish. Cue letter E should appear in WPT display. Last entered pattern length for CS pattern, if any, should appear in upper display, cuing next CS entry. Disregard this cue for VS patterns.

5. For VS patterns, depress INSERT again. VS indicator should extinguish signifying VS search pattern entry sequence is complete.

Enter Pattern Length for CS Patterns

1. Depress CLR key. Displays should blank.

2. Enter into keyboard CS pattern length in nautical miles (1 through 99). This number should appear in lower display.

3. Depress INSERT. Number should disappear from lower display. CS indicator should extinguish signifying CS search pattern entry sequence is complete.

EXAMPLE OF CS PATTERN ENTRY (Refer to figure 9-13).

CSP is at waypoint 1.

Leg length is 5.5 nautical miles.

Bearing of first leg is 43° TRUE.

Direction of first turn is right; track spacing is 0.8 nautical miles.

Pattern length is 12 nautical miles.

Search Pattern Readout

Use this procedure to display search patterns previously entered into the navigator.

1. MODE switch to OPERATE. DISPLAY switch to SF/PRL TK. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again. Cue letter A should appear in WPT display. Waypoint previously entered as Commence Search Waypoint should appear in upper display.

2. Depress INSERT to obtain next cue letter and associated search pattern data. Continue depressing INSERT until desired data is obtained.

3. Continue depressing INSERT until VS or CS indicator extinguishes.

Search Pattern Modification

Use this procedure to modify any portion of an existing search pattern.

1. MODE switch to OPERATE. DISPLAY switch to SF/PRL TK. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again. Cue letter A should appear in WPT display. Waypoint previously entered as Commence Search Waypoint should appear in upper display.

2. If Commence Search Waypoint number is to be changed, proceed as follows:

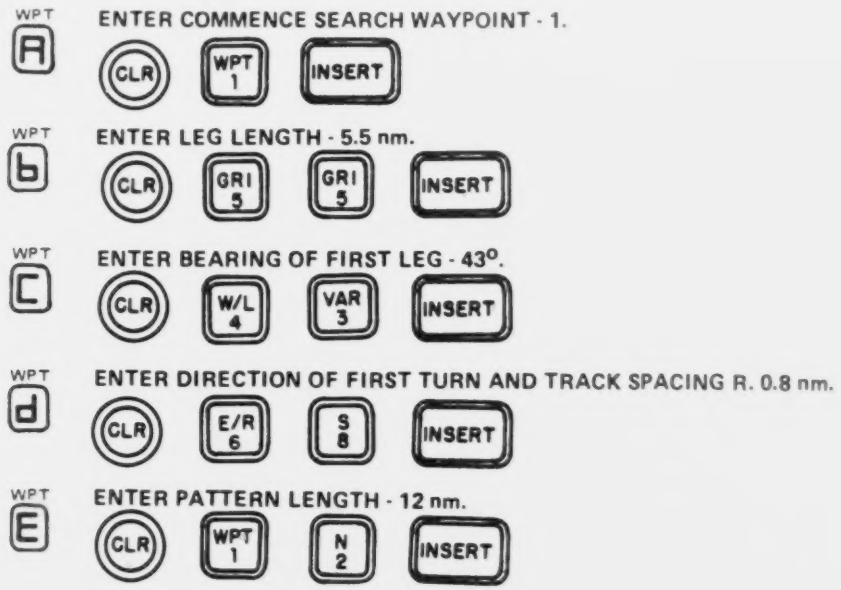


Figure 9-13. - CS Pattern Entry.

a. Depress CLR key. Displays should blank.

b. Enter into keyboard new commence search waypoint number. This number should appear in lower display.

c. Depress INSERT. Cue letter b should appear in WPT display, cuing next entry.

d. If any other pattern data is to be changed, depress INSERT until desired cue letter appears in WPT display. Enter new data as though making an original entry, using CS or VS search pattern input procedure.

3. If no other change is to be made in the pattern, continue depressing INSERT until the last cue (E) is removed and CS or VS indicator is extinguished.

SELF-QUIZ # 9

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. When turning the ARN-133 on, you should pause in the INITIALIZE position to prevent _____.

A. power fluctuations
B. transmitting a false emergency signal
C. freeze-up of the navigator
D. signal time warp

2. Self test (BITE) tests all the primary functions of the _____.

A. navigator
B. antenna
C. antenna coupler
D. antenna cable

3. GRI is the abbreviation for _____.

A. ground reflection inversion
B. group repetition interval
C. ground speed insertion
D. intermediate gain regulation

4. When changing from one GRI to another during flight you should _____.

A. turn the mode switch to pwr off and back to operate
B. wait ten minutes for the signal to track properly
C. make no more than four attempts to select a secondary pair
D. wait till the warn indicator is extinguished

5. The LORAN C Navigator tracks up to _____ secondary pairs.

A. one
B. two
C. three
D. four

6. In order to display, enter, or modify a waypoint, the display switch should be in the _____ position.

A. POSITION
B. WAY PT
C. DSR/TK
D. FF/VAR

7. Before entering the latitude of a waypoint located in Cleveland, Ohio the _____ key should be pushed.

A. N
B. S
C. E/R
D. W/L

8. While entering a CS search pattern, the cue letter b appears in the WPT display. You should enter _____.

A. leg length
B. bearing of first leg
C. direction of first turn
D. track spacing

9. After depressing INSERT key, the cue letter C appears. If you have no changes to the information already entered, you should depress the _____ key.

A. CLR
B. SEARCH
C. INSERT
D. DISPLAY HOLD

ANSWERS TO SELF-QUIZ #9

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF
1	C	9-3
2	A	9-9
3	B	9-10
4	D	9-10
5	D	9-11
6	B	9-3
7	A	9-14
8	A	9-15
9	C	9-15

Reading Assignment:
Pages 10-1 through 10-17.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Explain the preflight procedures of the navigator.
2. Explain the inflight procedures of the navigator.

LORAN C NAVIGATOR AN/ARN-133 (cont)

NAVIGATOR PREFLIGHT

NOTE

The following procedures are the minimum that should be accomplished by the copilot prior to takeoff when cockpit workload permits.

Procedures

1. MODE switch - Initialize.

2. DISPLAY switch - Position. Check/Insert lat/long of present position.

3. DISPLAY switch - TK/TKE. Check/Insert Loran C GRI and secondary pair selection. It is recommended that each unit establish a policy of inserting a standard Loran GRI and secondary pair for their home unit.

4. DISPLAY switch - FF/VAR - Check/Insert correct present position variation. It is recommended that each unit establish a policy of inserting a standard variation for their home unit.

5. DISPLAY switch - WAY PT. Depress CLR, WPT, 1, INSERT. Check/Insert lat/long of WPT 1. It is recommended that each unit establish a policy of always utilizing the lat/long of their home unit in position 1. If some other lat/long and variation are utilized in 1 during flight, the preflight lat/long and variation should be entered in 1 before the aircraft is secured.

6. Taxi clear of large buildings, hangars, or other obstacles.

WARNING

Loran C signal distortion may cause erroneous lockons near large metal objects.

7. MODE switch - OPERATE.

8. When WARN light extinguishes DISPLAY switch - POSITION.

9. Depress LORAN COORD key. TD indicator should illuminate. Check displayed TDA and TDB. Displayed information should be within 4.50 microseconds of that predetermined for the selected geographic location, GRI and specific secondary pair. Differences in excess of 4.50 microseconds indicate probable erroneous lockon. Reacquisition should be considered.

10. Depress LORAN COORD key - TD light should extinguish. Check displayed lat/long. Displayed information should be within 0.25 minutes of the lat/long represented by the TDA and TDB displayed in step 9. If differences in excess of 0.25 minutes are observed the Navigator is not converting TD's to lat/long correctly and should not be used for navigation. Perform the self test (BITE) to confirm Navigator performance.

11. Compare the displayed lat/long in step 10 to the predetermined lat/long for the selected geographic location. If not within 0.25 minutes of that predetermined lat/long perform update procedures.

NOTE

Regardless of error, correct position updating against a known geographical reference with known good LORAN-C reception will always provide more accurate navigation information.

INFLIGHT PROCEDURES

Leg Change Entry

Use the following procedure to define or redefine a flight leg, in either AUTO or MANUAL modes.

1. Set MODE switch to OPERATE.

2. Depress CLR Key. Displays should blank.

3. Depress LEG CHG key.

4. Enter into the keyboard the numbers of the new FROM waypoint and the number of the new TO waypoint, in that order. The new waypoints should appear in the lower display.

5. Depress INSERT. New waypoints should jump to the FR TO display. The WARN indicator will illuminate momentarily while the Navigator is calculating data for the new leg.

NOTE

If 0 was selected as the from waypoint, it will automatically become the present position displayed at the time the INSERT switch was depressed.

6. To advance to the next consecutive leg, depress CLR, LEG CHG, and INSERT. The next leg in numerical sequence should appear in the leg display.

Interwaypoint Range and Bearing

The navigator calculates distance and bearing from the designated FROM waypoint to the designated TO waypoint and displays this data for ten seconds. These computations are performed in lat/long, thus prohibiting interwaypoint range and bearing information for waypoints when either or both are stored in time differences. This is a remote function and does not affect navigation. Use the following procedure to obtain range and bearing from aircraft present position to any waypoint or from any waypoint to any other waypoint.

1. Verify that MODE switch is set to OPERATE. Set DISPLAY switch to DIST/BRG.

2. Depress CLR key. Displays should blank.

3. Depress WPT key.

4. Enter into keyboard the FROM and TO waypoints for which the range and bearing are desired. If range and bearing from aircraft present position to a waypoint are desired, enter 0 and the waypoint number. Numbers should appear in lower display.

5. Depress INSERT. Upper display should show distance; lower display should show bearing. The FROM TO waypoint numbers should appear in the FROM TO readout of the lower display. After ten seconds displays should revert to normal DIST/BRG display. If required longer, depress DISPLAY HOLD.

Converting Present Position Into A Waypoint

Present position can be frozen by depressing DISPLAY HOLD and then transferred to any waypoint by using the waypoint call up procedure. As many as nine points may be stored for reporting, etc. Use of this function does not interrupt normal navigational information to other waypoints.

1. Verify that MODE switch is set to OPERATE. DISPLAY switch may be in any position.

2. Select type of coordinates desired to store the present position, if time differences, depress LORAN COORD to illuminate the TD indicator; if lat/long, TD indicator must be extinguished.

3. When directly over the position, depress and release DISPLAY HOLD pushbutton. HOLD indicator should illuminate, aircraft present position is stored, and the displays are frozen.

4. Depress CLR key. Displays should blank.

5. Depress WPT key.

6. Enter into keyboard the number of the waypoint into which the desired position is to be stored. The selected waypoint number should appear in the lower display.

7. Depress INSERT. Stored values of the held position (whether lat/long or TD) become coordinates for the selected waypoint. HOLD indicator should extinguish and displays revert back to normal.

Position Updating

Position may be updated at any time. It is possible to compensate for propagation anomalies or map error by using position fixes of known accuracy. This is accomplished by entering the known fix in either TD's or lat/long, or by using coordinates previously stored in a waypoint. When the POS update function has been selected and the calibration coordinates have been entered, the INSERT key is depressed when directly over the selected calibration point (figure 10-1). At the instant of switch depression, the coordinates of that present position are measured and compared with the stored coordinates of the calibration point. The difference between the two positions is then used as a correction factor. The correction will be applied to all subsequent measurements until changed, deleted, or a change of secondaries is made. Normal data display is resumed with the proper correction added.

NOTE

Ensure the system is in track and stabilized by verifying that the WARN indicator is extinguished and the CS is settled before doing a POS update. This will ensure that the measured TD's have stabilized.

Time Difference Position Update

Use the following procedure to update system position against a known calibration point using manually entered time differences.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify that system is in track (WARN indicator extinguished). To observe the update, verify that TD indicator is illuminated.

2. Depress CLR key. Displays should blank.

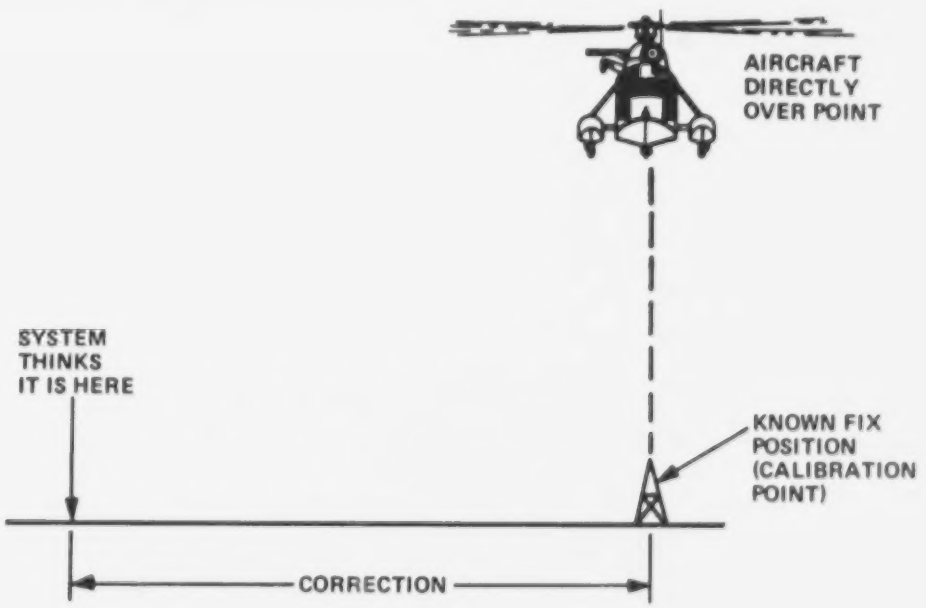
3. Depress POS key for position update.

4. Depress TDA key to select time difference A.

5. Enter into keyboard seven digits representing time difference A to hundredths of microseconds. Numbers should appear in upper display.

6. Depress INSERT.

7. Depress TDB key to select time difference B.



THREE KINDS OF POSITION UPDATING:
- TIME DIFFERENCE POSITION UPDATE
- LAT//LONG POSITION UPDATE
- WAYPOINT POSITION UPDATE

Figure 10-1. - Position Updating.

8. Enter into keyboard seven digits representing time difference B to hundredths of microseconds. Numbers should appear in lower display.

9. Depress INSERT key when directly over calibration point. Displays should return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

10. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish indicating correction is removed.

Lat/Long Position Update

Use the following procedure to update system position against a known calibration point using manually entered latitude and longitude coordinates.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify that system is in track (WARN indicator extinguished). To observe the update ensure that TD indicator is extinguished.

2. Depress CLR key. Displays should blank.

3. Depress POS key for position update.

4. Depress N (or S) latitude key. N (or S) indicator should illuminate.

5. Enter latitude into keyboard. Numbers should appear in upper display.

6. Depress INSERT.

7. Depress W (or E) longitude key. W (or E) indicator should illuminate.

8. Enter longitude into keyboard. Number should appear in lower display.

9. Depress INSERT key when directly over calibration point. Displays should return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

10. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish, indicating correction is removed.

Waypoint Position Update

Use the following procedure to update system position against a known calibration point using coordinates stored in a waypoint. Coordinates stored in the selected waypoint in either TD's or lat/long become the corrected position.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Verify the navigator is in track (WARN indicator extinguished).

2. Depress CLR key. Displays should blank.

3. Depress POS key for position update.

4. Depress WPT key for waypoint position update.

5. Enter into keyboard the waypoint number in which the coordinates have been stored for the calibration point. Selected waypoint number should appear in lower display.

6. Depress INSERT key when directly over calibration point. Displays return to normal. POS UPD indicator should illuminate, indicating correction factor is active.

7. To clear POS update, depress CLR, POS, and INSERT. POS UPD indicator should extinguish, indicating correction is removed.

Magnetic Variation Entry

Use the following procedure to enter or update the angle of magnetic variation. The TRUE indicator is illuminated when there is no magnetic variation inserted in the navigator.

1. MODE switch to INITIALIZE or OPERATE. To observe, set DISPLAY switch to FF/VAR. Magnetic variation may be entered in any position.

2. Depress CLR key. Displays should blank.

3. Depress VAR key.

4. Depress E (or W) key to select direction of variation. E (or W) indicator should illuminate.

5. Enter correct magnetic variation into keyboard to the nearest degree. Number should appear in upper display.

6. Depress INSERT. New variation is accepted and displays return to normal.

7. To clear the system of any magnetic variation, depress CLR, VAR, and INSERT. TRUE

indicator should illuminate, indicating bearing and course angle are with respect to true north.

8. To check entry, set DISPLAY switch to FF/VAR. New variation and direction should appear in lower display.

NOTE

Magnetic variation must be updated in 1° increments during flight progression for accurate navigation.

Parallel Track Navigation

Parallel track navigation facilitates flying parallel to a given course at a selected distance from it. The offset distance may be from 0.1 to 99.9 nautical miles. A series of such offset legs may be flown as determined by the number of waypoints entered in the system. Distance may be changed in mid-leg. The navigator completes this by projecting an artificial destination based on the nominal course coordinates and the offset distance entered. Figure 10-2 illustrates that in order for the navigator to compute the artificial destination 3', the coordinates of waypoints 2, 3, and 4 plus the offset distance, D, are necessary.

In manual mode, and in automatic when no subsequent waypoint coordinates have been entered, the offset destination is projected perpendicularly to the nominal course. In automatic mode, the offset destination is projected on the bisector of an angle between consecutive legs. Once the offset distance is entered, all navigation data is calculated with reference to the artificial destination. Original waypoint defined course is not lost, but held in storage until parallel track navigation is deselected. The following limitations apply.

1. Use of parallel track navigation at latitudes approaching the poles (±80° or more), is unreliable.

2. Since parallel track computations are performed in lat/long coordinates, use of parallel track navigation while a waypoint is stored as a TD pair is not possible.

3. Waypoint course should not contain any 180° turns.

Use the following procedure to obtain parallel track navigation:

1. MODE switch to OPERATE. To observe entry, set DISPLAY switch to SF/PRL TK.

2. Depress CLR key. Displays should blank.

3. Depress PRL TRACK key.

4. Depress L or R key to select either left or right of nominal course. L or R indicator should illuminate.

5. Enter into keyboard the desired offset distance to tenths of a nautical mile. (0.1 through 99.9 nautical miles). Selected offset distance should appear in lower display.

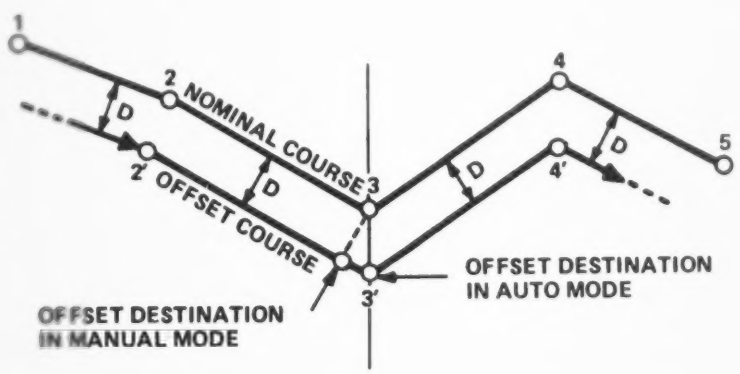


Figure 10-2. - Parallel Track Navigation.

6. Depress INSERT. PRL TRACK indicator should illuminate and displays should revert to selected function. Navigation is for the offset track.

7. To deselect parallel track navigation, depress CLR, PRL TRACK, and INSERT. PRL TRACK indicator should extinguish. Navigation should revert to normal.

Search Operation Using Prestored Patterns

Once any search pattern has been stored it may be called up and used in flight. The following procedures describe how to commence search on a prestored pattern, preform an optional manual leg advance during search, depart from and resume search, and terminate search.

NOTE

Prior to commencing a search, time should be allowed for the navigator to settle after initial lock-on. Correct (± 10 knots) ground-speed is indicative that settling has occurred. Failure to allow the equipment to stabilize, prior to assigning it a navigation task, will result in a non-convergence, possible lat-long runaway and memory saturation accompanied by loss of track and/or navigator.

Commence Search Pattern

To commence search use the following procedure.

1. MODE switch to OPERATE position. To observe, set DISPLAY switch to SF/PRL TK.

2. Depress CLR key. Displays should blank.

3. Depress LEG CHG key to initiate leg change.

4. Enter into the keyboard the single digit representing the approach leg FROM point. This is usually 0, representing aircraft present position. The TO point is the waypoint previously specified during search pattern storage as the Commence Search Point and need not be entered. Number should appear in lower display.

5. Depress SEARCH key. CS indicator should illuminate. If VS pattern is desired, depress SEARCH again; VS indicator should illuminate.

6. Depress INSERT. Leg display should show leg selected in step 4. AUTO MAN indication is set to AUTO. Upper display left-most three digits show number of legs to be flown in the search pattern; right-most three digits show number of legs completed. Lower display shows direction of next turn and course of next search leg. To manually advance legs while flying a search pattern, depress CLR, LEG CHG, and INSERT. Each time this is accomplished, the Navigator will advance navigation to the next leg and change the displays accordingly.

A commence search pattern example is illustrated in figure 10-3.

Depart from Search Pattern, Return, and Resume Search

To leave the scheduled search pattern and investigate a target, and then return to the point of departure to take up search where it was left off, use the following procedure:

1. During search, depress SEARCH key at the point where the pattern is departed. The active CS or VS indicator should flash on and off. The leg display should blank. The Navigator stores the aircraft position at the time of switch depression.

2. To resume the search pattern at the departure point depress SEARCH again. Active CS or VS indicator stops blinking and remains illuminated. Leg display shows OE (E signifying point or exit), and navigation is not provided from present position to point where the search pattern was left (step 1). Search pattern resumes where it left off.

Terminating Search

Use the following procedure to terminate the stored search pattern.

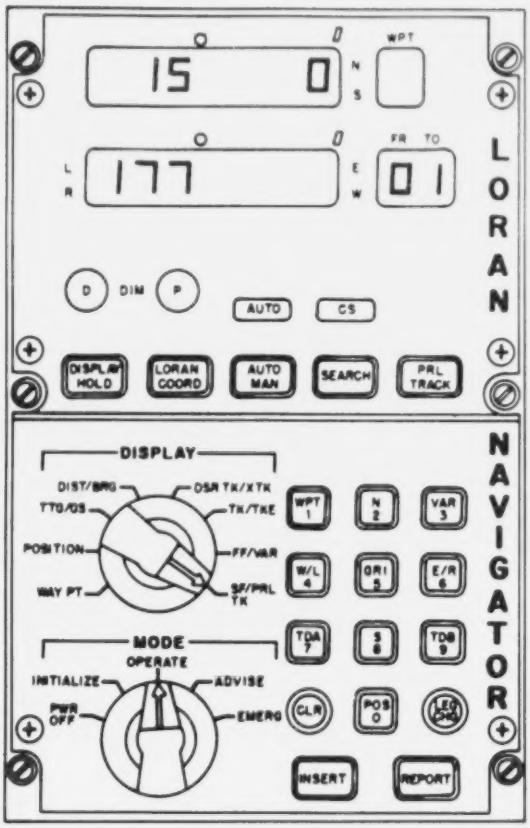
1. Depress CLR key. Displays should blank.

2. Depress SEARCH key. Active search indicator should blink.

3. Depress INSERT. Leg display is blanked.

NOTE

Initiating a standard leg change will also terminate search and activate navigation to the designated waypoint.



EXAMPLE:

COMMENCE SEARCH ON PRESTORED CS PATTERN USING WAYPOINT 1 AS STARTING WAYPOINT.

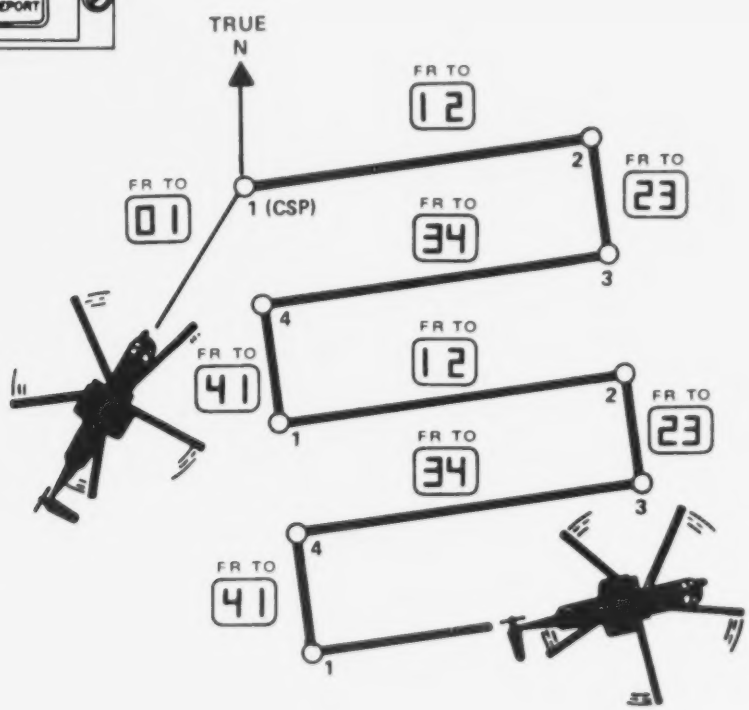


Figure 10-3. - Commence Search Pattern.

Rho-Theta Navigation

The rho-theta navigation function (figure 10-4) calculates the latitude and longitude of a waypoint that lies at a given distance (rho), and bearing (theta) from a given waypoint or present position. This function may be used in two ways:

1. To have the navigator calculate lat/long of the projected point and store it in a specified waypoint for future use.

2. To have the navigator calculate the lat/long of the projected point, store it, and automatically initiate a leg change to provide navigation to that point.

NOTE

The navigator will not accept entries of rho distances over 250 nautical miles.

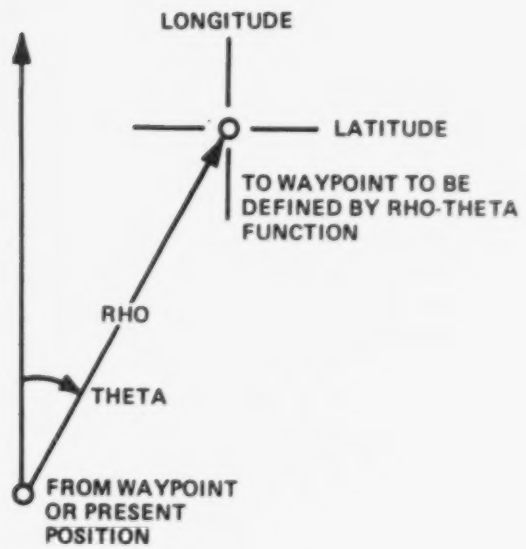


Figure 10-4. - Rho-Theta Navigation.

Use the following procedure to obtain rho-theta navigation.

1. MODE switch to OPERATE and DISPLAY switch to DIST/BRG.

2. Depress CLR key. Displays should blank.

3. Depress WPT and LEG CHG keys to initiate the function.

4. To store the projected point as a waypoint without obtaining navigation to it, enter the single digit of the FROM waypoint from which rho and theta are to be calculated. To obtain navigation information to the projected point, enter 0 for the FROM waypoint. Entering 0 designates present position. Number should appear in lower display.

5. Enter the single digit of the TO waypoint to be defined by the rho-theta function. Number should appear in lower display.

6. Depress INSERT.

7. Enter up to four digits of range (rho) in nautical miles and tenths, up to 250 nautical miles maximum. Range should appear in upper display.

8. Depress INSERT.

9. Enter up to three digits of bearing (theta) in degrees. Bearing should appear in lower display.

10. Depress INSERT. The navigator will calculate the lat/long of the projected point and store this in the selected TO waypoint. If a FROM waypoint of 0 was entered, a leg change will be automatically initiated and navigation to the calculated point will be provided. DIST/BRG will be displayed.

SPECIAL PROCEDURES

Master Independence

NOTE

Master independent operation is not obtainable when using a manually stored chain for navigation.

The AN/ARN-133 is designed to operate without the master Loran signal when at least three secondaries are available and can be adequately received. This allows operation in cases where the master signal is not initially receivable or is lost after navigation has begun. In such cases, the Navigator designates a secondary as master and new LOP's are calculated. When the master signal becomes receivable again, it is picked up and treated as another secondary. This feature operates automatically without operator action, but may be overridden (master independence override). The ADVISE indicator illuminates when master independence is enabled. And when the MODE switch is set to ADVISE and the DISPLAY switch to DIST/BRG, the right-most digit in the lower display indicates which secondary is designated as the master. When this digit is 0, the

navigator has the real master and is operating normally; when this digit is 1, 2, 3, or 4, it identifies which secondary is being used as the master. With the DISPLAY switch at DSR TK/XTK, a "1" in the "No Master" digit of the upper display (middle digit) indicates the Navigator does not have a master. This may also indicate master independence, but not decisively. When master independence is operative, the position update function (POS UPD) is inoperative as the position update capability is based on the real master-referenced system. Master independence also disables the automatic secondary change advise function.

Master Independence Override

To override master independence (deactivate the function) in cases where it is known the navigator will take longer than usual to find the master, use the following procedure:

1. Set MODE switch to ADVISE and DISPLAY switch to DSR TK/XTK.

2. Depress CLR key. Displays should blank.

3. Depress 4 key to identify master override function.

4. Enter number 8 into keyboard. 8 should appear in lower display (and in proper ADVISE work digit), indicating override.

5. Depress INSERT. Displays should return to normal; master independent override is in effect.

To remove master independence override (allow master independence operation), use the following procedure:

1. MODE switch to ADVISE and DISPLAY switch to DSR TK/XTK.

2. Depress CLR key. Displays should blank.

3. Depress 4 key to identify master override function.

4. Enter number 0 into keyboard. 0 should appear in lower display (and in proper ADVISE work digit), indicating normal operation of master independence.

5. Depress INSERT. Displays should return to normal; master independence operation is not permitted to function normally.

Loran Cycle Jump

This procedure permits changing the cycle being tracked by the navigator. The tracking point can be moved either one cycle ahead or behind the cycle currently being tracked. This should be done when the navigator locks on 10 usecs off.

1. MODE switch to OPERATE and DISPLAY switch to POSITION. Depress LORAN COORD switch as necessary so TD indicator illuminates.

2. Depress CLR key. Displays should blank.

3. Depress GRI key.

4. To move the master tracking point, proceed to step five. To move the A secondary, depress TDA key; to move the B secondary, depress TDB key. N and S indicators should illuminate with TDA selection; E and W indicators should illuminate for TDB selection.

5. If jump is to be made to the left (-), depress L key; if jump is to be made to the right (+), depress R key. Appropriate L or R indicator should illuminate.

6. Depress INSERT. For secondary A or B (-) jumps, the time difference should decrease by ten microseconds, for (+) jumps, the time difference should increase by ten microseconds. For master jumps, the shift will be + or - five microseconds, but there is no visible display indication of this.

Manual Chain Storage

The AN/ARN-133 stores the required data for 14 LORAN chains. All of these, plus the 5100 BITE chain used for self test, are permanently stored in memory and can be selected by using the GRI selection procedure. The navigator allows for manual storage of one additional chain, providing versatility for storing every aspect of any LORAN C or D chain. As a guide through the storage procedure, step numbers appear in the FR TO display, and substep numbers appear when applicable in the lower display. In addition, data from any previously stored manual chain appears in upper and lower displays, cuing the type of entry to be made. To correct errors after any INSERT, it is necessary to display the step number in which the mistake was made. To accomplish this, either move the MODE switch out of INITIALIZE momentarily and then back, resetting the step to 01, or depress INSERT as necessary to step to the end of the cue sequence and back to the

desired step. To correct data entered in any step, reenter the correct data over the incorrect.

Use the manual chain storage procedure for any chain not listed in figure 10-7.

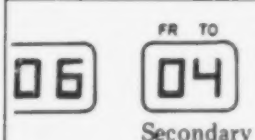
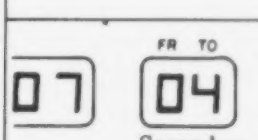
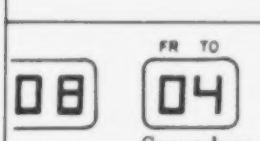
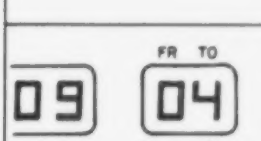
MANUAL CHAIN STORAGE PROCEDURE

Display Counters	Operator Action	System Response
	1. Set MODE switch to INITIALIZE and DISPLAY switch to SF/PRL TK.	Upper display shows previous manual chain GRI. FR TO counter is set to 01.
Enter GRI	1. Depress CLR key. 2. Enter into keyboard seven-digit GRI, using zeros if necessary. Enter only in increments of 2.5 microseconds, entering a trailing zero after the sixth digit. 3. Depress INSERT. Note: The TDL-424 will only track real-world GRI's in increments of 2.5 microseconds (far greater resolution than required for any foreseeable chain), even though any GRI number can be entered.	Displays should blank. GRI should appear in upper display. FR TO counter advances to 02; previous number of secondaries should appear in upper display.
Specify no. of secondaries	1. Depress CLR key. 2. Enter 2, 3, or 4, specifying number of secondaries in chain. 3. Depress INSERT.	Displays should blank. Number appears in upper display. Counter advances to 03. Previous Loran C or D selection is displayed.
Specify Loran C or D	1. Depress CLR key. 2. Enter 1 or 2, specifying Loran C or D. 1 = C; 2 = D. 3. Depress INSERT.	Displays should blank. Number appears in upper display. Counter advances to 04. Previous phase code type is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
 Specify type of phase code	1. Depress CLR key. 2. Enter N or S, specifving new or standard phase code. (For definition of standard phase code, see new phase code preparation procedure.) NOTE All active Coast Guard Loran C chains use standard phase coding. 3. Depress INSERT. If standard phase code (S) was selected, proceed to 05 instruction, below.	Displays should blank. Appropriate N or S indicator should light. If S was selected counter advances to 05. If N was selected, counter remains at 04 and lower display reads 01, indicating substep; previous phase code value is displayed.
 Master interval A	1. Depress CLR key. 2. Enter six-digit octal phase code for master, interval A. (Obtain this and subsequent numbers by performing new phase code preparation procedure.) 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 02. previous master interval B code is displayed.
 Master interval B	1. Depress CLR key. 2. Enter six-digit octal phase code for master, interval B. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 03. Previous master interval C code is displayed.
 Master interval C	1. Depress CLR key. 2. Enter six-digit octal phase code for master interval C. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 04. Previous master interval D code is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
Master interval D	1. Depress CLR. 2. Enter six-digit octal phase code for master interval D. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 05. Previous secondary 1 interval A code is displayed.
Secondary 1, interval A	1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval A. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 06. Previous secondary 1 interval B code is displayed.
 Secondary 1, interval B	1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval B. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 07. Previous secondary 1 interval C code is displayed.
 Secondary 1, interval C	1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval C. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 08. Previous secondary 1 interval D code is displayed.
 Secondary 1, interval D	1. Depress CLR. 2. Enter six-digit octal phase code for secondary 1 interval D. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 09. Previous secondary 2 interval A code is displayed.
 Secondary 2, interval A	1. Depress CLR key. 2. Enter six-digit octal phase code for secondary 2 interval A. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 10. Previous secondary 2 interval B code is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
10 FR TO 04 Secondary 2, interval B	1. Depress CLR key. 2. Enter six-digit octal phase code for secondary 2, interval B. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 11. Previous secondary 2 interval C code is displayed.
11 FR TO 04 Secondary 2, interval C	1. Depress CLR key. 2. Enter six-digit octal phase code for secondary 2, interval C. 3. Depress INSERT.	Displays should blank. Code should appear in upper display. Substep counter advances to 12. Previous secondary 2 interval D code is displayed.
12 FR TO 04 Secondary 2, interval D	1. Depress CLR key. 2. Enter six-digit octal phase code for secondary 2, interval D. 3. Depress INSERT. Note: Steps 13 through 16 are for entering octal phase codes for intervals A through D of secondary 3. Steps 17 through 20 are for entering octal phase codes for intervals A through D of secondary 4. If a 3 was entered in step 02, perform steps 13 - 16; if a 4 was entered, perform steps 17 - 20.	Displays should blank. Code should appear in upper display. If a 2 was entered in step 02, signifying two secondaries, lower display should blank and FR TO counter should advance to 05 with previous master latitude shown in upper display. If a 3 or 4 was entered in step 02, lower display counter will advance to 13.
FR TO 05 Master latitude	1. Depress CLR key. 2. Depress N or S key to designate latitude of master. 3. Enter latitude of master. 4. Depress INSERT.	Displays should blank. N or S indicator should light. Latitude should appear in upper display. Counter advances to 06. Previous longitude of master is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
FR TO 06 Master longitude	1. Depress CLR key.	Displays should blank.
	2. Depress E or W key to designate longitude of master.	E or W idicator should light.
	3. Enter longitude of master.	Longitude should appear in lower display.
	4. Depress INSERT.	Counter advances to 07. Previous secondary 1 emission delay is displayed.
FR TO 07 Secondary 1 emission delay	1. Depress CLR key.	Displays should blank.
	2. Enter seven-digit emission delay for secondary 1 (coding delay + baseline in microseconds).	Emission delay should appear in upper display.
	3. Depress INSERT.	Counter advances to 08. Previous secondary 1 latitude is displayed.
FR TO 08 Secondary 1 latitude	1. Depress CLR key.	Displays should blank.
	2. Depress N or S key to designate latitude of secondary 1.	N or S indicator should light.
	3. Enter six-digit latitude of secondary 1.	Latitude should appear in upper display.
	4. Depress INSERT.	Counter advances to 09. Previous secondary 1 longitude is displayed.
FR TO 09 Secondary 1 longitude	1. Depress CLR key.	Displays should blank.
	2. Depress E or W key to designate secondary 1 longitude.	E or W indicator should light.
	3. Enter six or seven-digit longitude for secondary 1.	Longitude should appear in lower display.
	4. Depress INSERT.	Counter advances to 10. Previous secondary 2 emission delay is displayed.
FR TO 10 Secondary 2 emission delay	1. Depress CLR key.	Displays should blank.
	2. Enter seven-digit emission delay for secondary 2.	Emission delay should appear in upper display.
	3. Depress INSERT.	Counter advances to 11. Previous secondary 2 latitude is displayed.

MANUAL CHAIN STORAGE PROCEDURE (Continued)

Display Counters	Operator Action	System Response
FR TO 11 Secondary 2 latitude	1. Depress CLR key.	Displays should blank.
	2. Depress N or S key to designate latitude of secondary 2.	N or S indicator should light.
	3. Enter six-digit secondary 2 latitude.	Latitude should appear in upper display.
	4. Depress INSERT.	Counter advances to 12. Previous secondary 2 longitude is displayed.
FR TO 12 Secondary 2 longitude	1. Depress CLR key.	Displays should blank.
	2. Depress E or W key to designate secondary 2 longitude.	E or W indicator should light.
	3. Enter seven-digit longitude of secondary 2, using zeros where applicable.	Longitude should appear in lower display.
	4. Depress INSERT.	Counter will reset to 01 if two secondaries were specified, indicating entry is complete. Counter will advance to 13 if three or four secondaries were specified.
	Note: Steps 13 - 15 are for secondary 3 emission delay, latitude and longitude; steps 16 - 18 are for secondary 4 emission delay, latitude and longitude. If applicable, perform these steps using same format as for secondaries 1 and 2.	

NEW PHASE CODE PREPARATION PROCEDURE

Standard phase codes are defined below. If the phase code to be used in manual chain entry deviates from this standard by as much as one bit, it is considered a new (N) phase code, and the following phase code preparation procedure must be followed.

LORAN-C Standard Phase Code

(1 = + or in phase; 0 = − or 180° out of phase)

Time ⟶

1 1 0 0 1 0 1 0 Master, interval A (and C)
1 0 0 1 1 1 1 1 Master, interval B (and D)
1 1 1 1 1 0 0 1 Each secondary interval A (and C)
1 0 1 0 1 1 0 0 Each secondary interval B (and D)

LORAN-D Standard Phase Code (Air Force Definition)

Time ⟶

1 1 1 1 0 1 0 0 1 1 0 1 1 0 0 1 Master interval A
1 1 0 1 0 1 1 0 1 0 1 0 1 1 1 0 Master interval B
1 0 1 0 0 0 0 1 1 0 0 0 1 1 0 0 Master interval C
1 0 0 0 0 0 1 1 1 1 1 1 1 0 1 1 Master interval D

1 1 1 0 1 1 1 1 1 0 0 1 0 1 1 1 Secondary 1,3,4 Int.A
1 0 0 1 1 0 0 0 1 0 1 1 0 1 0 1 Secondary 1,3,4 Int.B
1 0 1 1 1 0 1 0 1 1 0 0 0 0 1 0 Secondary 1,3,4 Int.C
1 1 0 0 1 1 0 1 1 1 1 0 0 0 0 0 Secondary 1,3,4 Int.D

1 1 1 0 1 1 1 1 1 1 0 0 0 0 1 0 Secondary 2 Int. A
1 1 0 0 1 1 0 1 1 0 1 1 0 1 0 1 Secondary 2 Int. B
1 0 1 1 1 0 1 0 1 0 0 1 0 1 1 1 Secondary 2 Int. C
1 0 0 1 1 0 0 0 1 1 1 0 0 0 0 0 Secondary 2 Int. D

EXAMPLE:

PROBLEM: To make secondary 2 phase codes the same as secondary 1, 3, and 4 for LORAN-D. Since this is a deviation from standard, it is necessary to start at the beginning and enter all phase codes. Begin by entering the master codes, even though they do not change.

a. Start by writing down the Master interval A phase code with time flow from left to right:

Time ⟶

1 1 1 1 0 1 0 0 1 1 0 1 1 0 0 1

b. Then write the data from right to left:

⟵ Time

1 0 0 1 1 0 1 1 0 0 1 0 1 1 1 1

c. Add two leading zeros and group the data bits in groups of three:

0 0 1 0 0 1 1 0 1 1 0 0 1 0 1 1 1 1

d. Assign a binary value for each bit as shown below. This puts the data in binary coded octal format for entry into the computer.

4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	Binary value
0 0 1	0 0 1	1 0 1	1 0 0	1 0 1	1 1 1	Data

e. Determine the numeric value of each group of three bits as shown below, and write each number below its respective group.

4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	Binary value
0 0 1	0 0 1	1 0 1	1 0 0	1 0 1	1 1 1	Data
1	1	5	4	5	7	Octal value

Example: 4 + 2 + 1 = 7

f. This six-digit octal number is the octal phase code to be entered in manual chain entry substep 01.

01. 1 1 5 4 5 7

g. Repeat this procedure for master interval B as follows:

Time ⟶

1 1 0 1 0 1 1 0 1 0 1 0 1 1 1 0

Reversed:

⟵ Time

0 1 1 1 0 1 0 1 0 1 1 0 1 0 1 1

Grouped, two leading zeros added, and converted:

4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	Binary value
0 0 0	1 1 1	0 1 0	1 0 1	1 0 1	0 1 1	Data
0	7	2	5	5	3	Octal value

h. Enter on worksheet for substep 02:

02. 0 7 2 5 5 3

i. Repeat this procedure until all phase codes for the master and each secondary are defined for all four intervals. To complete this example, the numbers to be entered for master interval C and D would be, respectively.

03. 0 3 0 6 0 5 and 04. 1 5 7 7 0 1

j. Calculate all four secondaries (or as many as there are in the chain) in a similar manner. Since, for this example, we are making secondary 2 phase codes the same as secondaries 1, 3, and 4, the four phase code entries would be as follows:

05. 1 6 4 7 6 7 Interval A
09.
13.
17.

06. 1 2 6 4 3 1 Interval B
10.
14.
18.

07. 0 4 1 5 3 5 Interval C
11.
15.
19.

08. 0 0 3 6 6 3 Interval D
12.
16.
20.

k. If the new phase codes are for a LORAN-C chain (eight pulses per group instead of 16), the 16 pulse format must still be followed. To do this, insert a zero between each bit of the LORAN-C phase codes, and after reversal, add three leading zeros. This maintains the proper pulse spacing in the computer. As an example, the two master interval phase codes would be calculated as follows:

Time ⟶

1 1 0 0 1 0 1 0

Reversed: ⟵

0 1 0 1 0 0 1 1

Inserting zero between bits and adding three leading zeros (as underlined):

0 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 1

Grouped and converted:

4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	Binary value
0 0 0	0 0 1	0 0 0	1 0 0	0 0 0	1 0 1	Data
0	1	0	4	0	5	Octal value

This data must not be entered for substeps 01 and 03, since the LORAN-C phase codes repeat every two intervals, rather than every four:

01. 0 1 0 4 0 5 03. 0 1 0 4 0 5

Similarly, substeps 02 and 04 would calculate out as follows:

1 0 0 1 1 1 1 1

Reversed:

1 1 1 1 1 0 0 1

Zeros added, grouped, and converted:

4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	4 2 1	Binary value
0 0 0	1 0 1	0 1 0	1 0 1	0 0 0	0 0 1	Data
0	5	2	5	0	1	Octal value

Calculate the secondaries in a similar fashion.

SELF-QUIZ # 10

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. During preflight, erroneous lockon is indicated by a _____.

   A. TDA 2.50 microseconds different than predetermined selection
   B. TDB 5.50 microseconds different than a predetermined selection
   C. flashing CS indicator
   D. flashing WARN indicator

2. The three kinds of position updating are _____.

   A. TIME DIFFERENCE, LAT/LONG, WAYPOINT
   B. TIME DIFFERENCE, LEG CHG, WAYPOINT
   C. TIME DIFFERENCE, LEG CHG, LAT/LONG
   D. WAYPOINT, LEG CHG, LAT/LONG

3. Parallel Track Navigation is used to _____.

   A. follow a course previously flown by another aircraft
   B. fly above the 80° latitude range (North Pole)
   C. make turns that are greater than 180°
   D. fly an offset course to that already programmed

4. The LORAN C navigator will not accept rho distances over _____ nautical miles.

   A. 150
   B. 175
   C. 200
   D. 250

5. The ARN-133 will operate properly _____.

   A. when no master signal is received by using a secondary station as master
   B. when only the master signal is received by assuming secondary positions
   C. when only one secondary station is received and no master by assuming master position
   D. when, after lockon, all signals are lost, by operating in the memory mode

6. The ARN-133 stores data for _____ LORAN chains.

   A. 10 GRI and 2 manual
   B. 12 GRI and 4 manual
   C. 14 GRI and 1 manual
   D. 16 GRI and 3 manual

7. 03 appears in the Display Counters when entering a manual LORAN chain GRI. You enter a 1 to indicate that the GRI is LORAN _____.

   A. A
   B. B
   C. C
   D. D

8. Add two zeros to the front of the LORAN D PHASE CODE 1011101011000010. When converted to actual octal for entry in the manual chain entry substep, this number should read _____.

   A. 135302
   B. 146402
   C. 565410
   D. 676510

ANSWERS TO SELF-QUIZ # 10

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	10-1
2	A	10-3
3	D	10-5
4	D	10-8
5	A	10-8
6	C	10-9
7	C	10-10
8	A	10-16

FLIGHT DIRECTOR SYSTEMS

Reading Assignment:
Pages 11-1 through 11-10.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the AN/AYN-2 system and its components.
2. Summarize the flight director modes of operation.
3. Explain the preflight procedures for the flight director system.

FLIGHT DIRECTOR AN/AYN-2

Each pilot is provided with a complete flight director system (figure 11-1). The flight director system provides an easily interpreted pictorial display of the helicopter navigation situation, and it automatically computes the required action to obtain a desired radio track or heading. The information is displayed continuously, and any system failure is normally indicated by means of flag circuitry. The copilot's flight director requires attitude and azimuth inputs from the A/A24G-39. The pilot's flight director requires azimuth inputs from the A/A24G-39 and attitude inputs from the 1080Y vertical gyro.

The flight director is powered by the No. 1 AC primary bus and is protected by three circuit breakers on the copilot's circuit breaker panel. Two of the circuit breakers, under the general heading NO 1 AC PRI FLT DIR and HEADING, are marked PILOT ØB and CO-PILOT ØB respectively. The third circuit breaker is under the general heading NO 1 AC PRI and is marked ATTITUDE CO-PILOT ØB.

Power for the A/A24G-39 system is supplied from the No. 1 AC primary bus, the DC primary bus, and the two autotransformers that operate from the No. 1 AC primary bus. The system is protected by circuit breakers on the copilot's overhead circuit breaker panel. One circuit breaker, under the general heading No. 1 AC PRI, is marked GYRO COMPASS, the other, under the general heading DC PRI, is marked GYRO COMPASS.

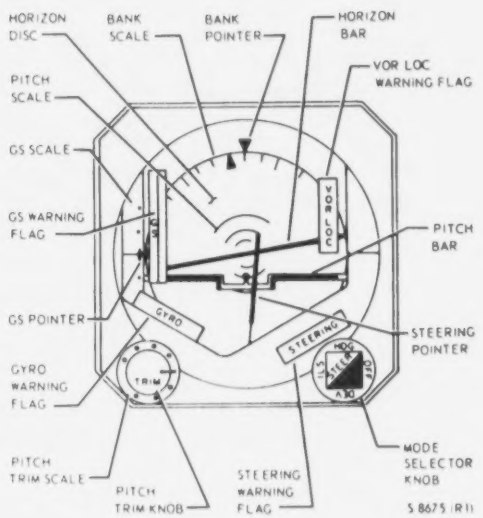


Figure 11-1. - Flight director set AN/AYN-2 attitude indicator.

The flight director system consists of four components: steering computer, attitude indicator, course indicator, and instrument amplifier.

WARNING

If the radio transformer fails and the pilot is using TACAN inputs to the AYN-2, no visual warning will be displayed on the flight director or any other flight instrument to indicate system failure.

STEERING COMPUTER

The steering computer provides the pilot with steering information via the attitude indicator. The steering computer computes a horizontal guidance signal from TACAN/VOR or localizer, heading error, and bank angle data. The horizontal guidance signal is displayed on the attitude indicator by means of the steering pointer. Necessary corrective measures to the approach, selected heading, and radio path are thus provided to the pilot. A steering warning service is provided by flag circuits.

ATTITUDE INDICATOR

The steering and glide slope pointers of the attitude indicator (figure 11-2) provide guidance in intercepting and following localizer and glide slope beams or for maintaining a selected heading or course. Warning flags indicate any malfunction in the glide slope, localizer, VOR, TACAN, attitude display, or steering signal system. The steering computer horizontal guidance signal is displayed by means of the steering pointer. Precise lateral control may be achieved by maneuvering the helicopter to maintain the steering pointer in the centered position. The glide slope pointer indicates displacement of the helicopter from the glide slope path. The position of the glide slope pointer, relative to the pitch indicator, indicates the flight correction required to achieve a smooth approach. The horizontal and vertical guidance indicators described above are superimposed on an artificial horizon. The artificial horizon consists of pitch and bank indicators and provides continuous monitoring of the flight attitude.

Steering Flag

Depending on the position of the mode selector switch, failure of the A/A24G-39 vertical gyro or directional gyro, remote indicating compass, or radio inputs causes the STEERING flag to be displayed. Loss of steering computer primary power would cause the flag to be displayed regardless of the mode switch position.

Gyro Flag

Failure of the A/A24G-39 vertical gyro driving the copilot's attitude display, or the 1080Y vertical gyro driving the pilot's attitude display, causes the appropriate GYRO flag to appear. Failure of the A/A24G-39 vertical gyro also affects the pilot's and copilot's steering circuitry. Set the mode selector to the DEV position and use the pilot's approach indicator as the primary attitude indicator.

VOR LOC Flag

The VOR LOC flag is in view when the signal from the helicopter TACAN/VOR or localizer receiver is inadequate. The flag will be in view when the receiver is malfunctioning, turned off, or not tuned to a sufficiently strong TACAN, VOR, or localizer frequency.

GS Flag

The GS flag appears when signals from the glide slope receiver are inadequate for driving the glide slope pointer.

Pitch Bar

The pitch bar (A, figure 11-2) represents imaginary wings and moves up and down as helicopter pitch changes. The level flight position of the bar may be changed, for reference during cruise, by rotating the TRIM knob. The pitch bar trim is preset when the mode selector is in the ILS position.

Steering Pointer

Deflections of the steering pointer (B, figure 11-2) are commands to establish a selected course or heading. The pilot always flies the helicopter to bank toward the pointer. Proper bank angle is established when the steering pointer centers. When on course, keeping the steering pointer centered will establish the crab angle required to correct for possible crosswind conditions in the ILS and DEV modes. With the mode switch in DEV position, steering pointer deflections are no longer bank commands. The pointer shows the direction to turn to attain the selected course. Degree of bank is not included in this command since the pointer will center only when the helicopter is actually on the selected course. DEV mode may be used as backup in the event of steering computer failure.

Horizon Bar

As seen by the pilot, the horizon bar (C, figure 11-2) tilts in the same sense the real horizon tilts as helicopter bank changes. A pointer at the top of the attitude indicator and index marks on the horizon disc indicate aircraft bank in graduations of 10, 20, 30 and 45 degrees.

Glide Slope Pointer

The displacement from the glide path is shown by the glide slope pointer (D, figure 11-2). The glide slope is flown by adjusting power to keep the glide slope pointer and the pitch bar aligned while desired airspeed is maintained.

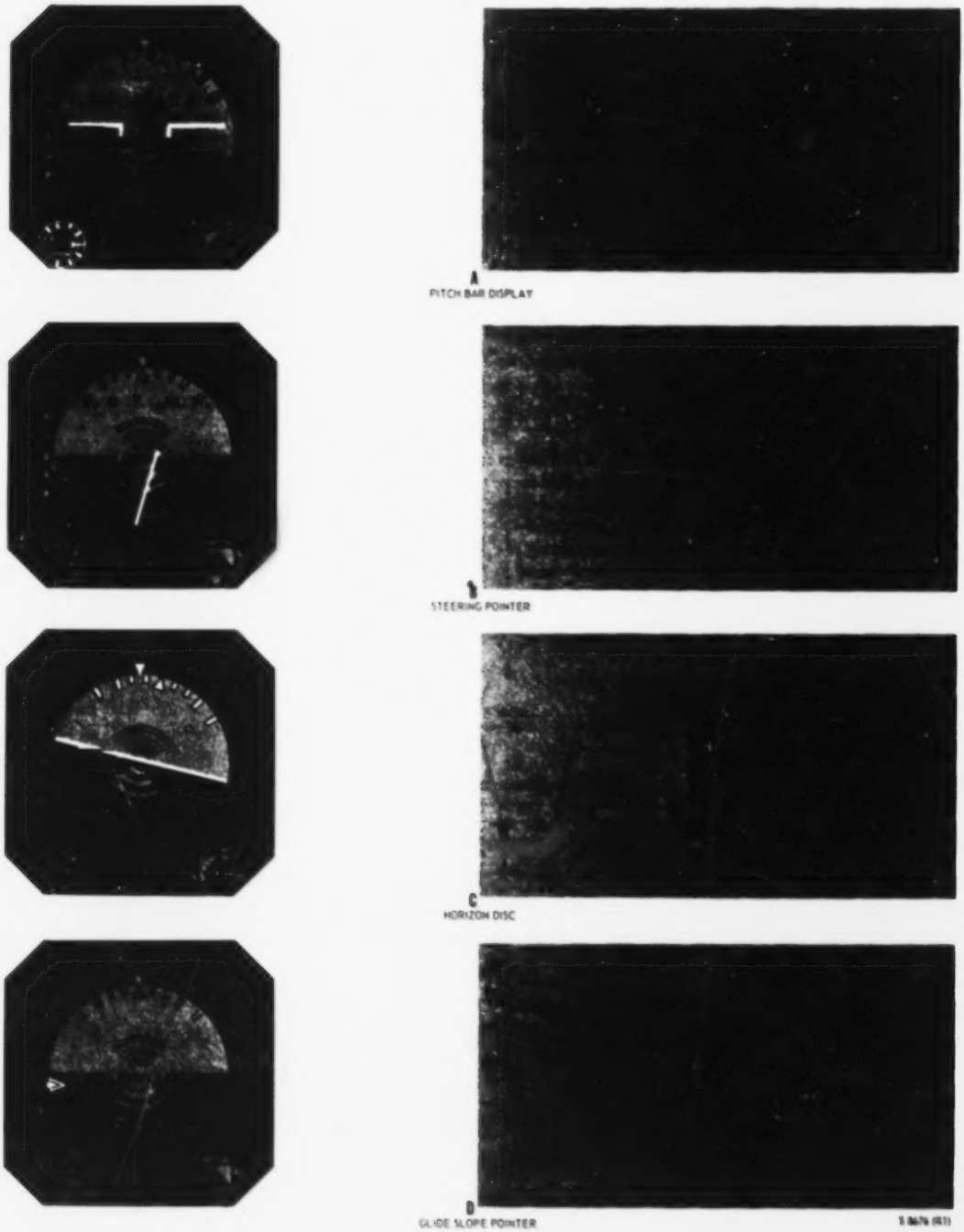


Figure 11-2. - Attitude indicator AN/AYN-2.

COURSE INDICATOR

The course indicator (figure 11-3) displays a pictorial plan view of the helicopter with respect to magnetic north, selected course, and selected heading. Heading, heading deviation, selected heading, selected course, and crab angle are read against a servo-driven azimuth card. The selected TACAN, VOR, and localizer course is displayed pictorially and by means of a digital COURSE counter. A digital distance display is also provided on the course indicator. Meter movements not only display course deviation, to-from indication, and glide slope location, but also operate warning flags. The warning flags monitor heading, display, and radio signals. A stationary symbolic aircraft, located in front of the course deviation pointer, provides the pictorial presentation of helicopter position and heading. The course indicator requires a remote amplifier for the azimuth servo system. Selected course and heading may be set manually.

VOR LOC Flag

See ATTITUDE INDICATOR, VOR LOC Flag.

GS Flag

See ATTITUDE INDICATOR, GS Flag.

HDG Card Flag

A malfunction in the A/A24G-39 system will bring the HDG CARD flag into view. The heading circuits also supply data to the steering pointer circuits. Set the mode selector to the DEV position. The steering pointer will show deviation from the selected course. Readings of all other parts of the displays are correct regardless of the condition of the heading circuitry.

Symbolic Aircraft

The aircraft outline fixed behind the instrument face is symbolic of the helicopter (A, figure 11-4). Moving portions of the course indicator relate to the symbolic aircraft to provide a map-like display of the actual flight situation.

Azimuth Card and Lubber Line

The azimuth card turns as the helicopter turns; the symbolic aircraft is always pointed toward the actual helicopter heading as read on the azimuth card (B, figure 11-4). The helicopter heading may be read accurately under the lubber line at the top of the instrument. A series of index marks are inscribed around the azimuth card for reference at the start of turns.

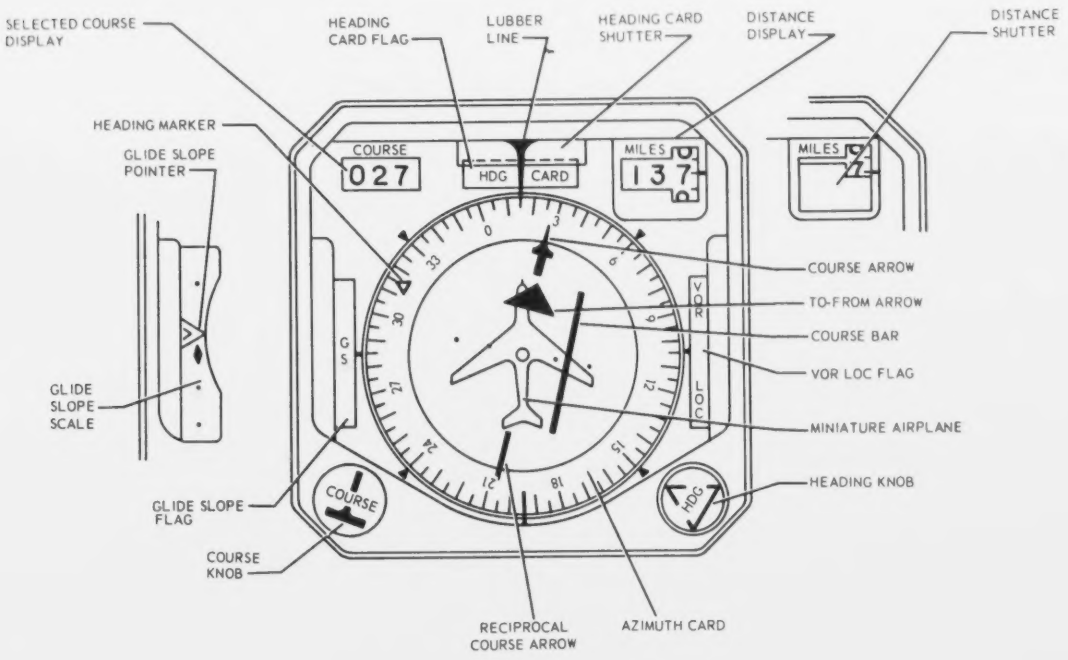


Figure 11-3. - AN/AYN-2 course indicator.

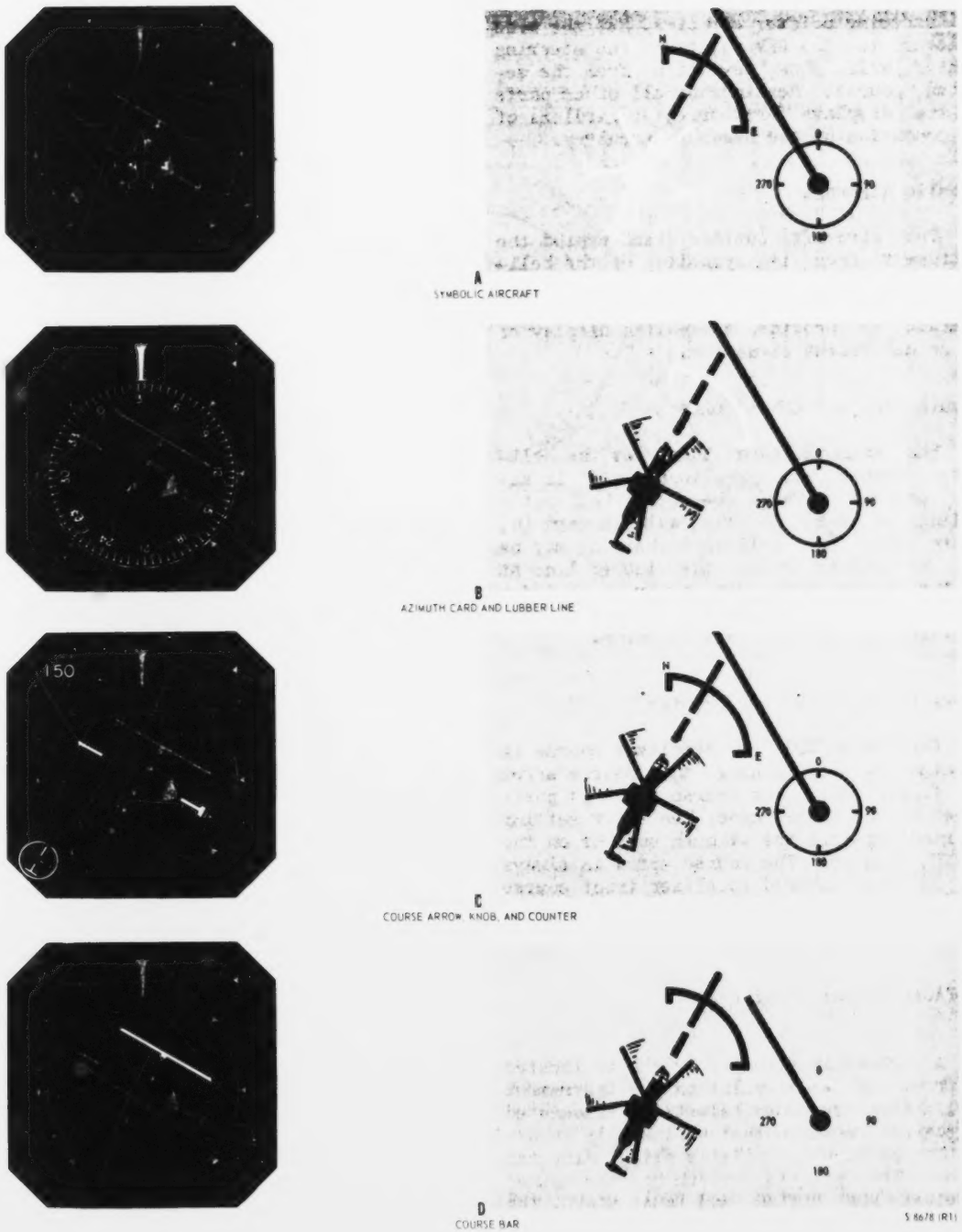


Figure 11-4. - Course indicator AN/AYN-2.

Course Arrow, Knob, and Counter

The TACAN/VOR or localizer course is selected by positioning the course arrow (C, figure 11-4). The course arrow is positioned by the COURSE knob. The arrow setting is read against the azimuth card or on the COURSE counter. The course arrow is always set to the inbound localizer front course even if a back course approach is being flown.

VOR-TACAN Selector Switches

A VOR-TACAN selector switch is located in front of each pilot on the instrument panel. The switches select the associated navigation receiver that will supply inputs to the particular pilot's flight director system. The pilot's switch has the marked positions VOR MASTER and TACAN SLAVE. The copilot's switch has marked positions VOR SLAVE and TACAN MASTER. The MASTER/SLAVE marking remind both pilots that only the pilot's course knob controls both flight director system displays when the VOR or localizer receiver is being used. In addition, only the copilot's course knob controls both flight director displays when the TACAN receiver-transmitter is being used.

WARNING

Power failure to the VHF NAV receiver will cause TACAN information to be automatically displayed on the copilot's flight director system regardless of the VOR-TACAN selector switch position.

NOTE

When either the pilot's or copilot's VOR-TACAN selector switch is in the MASTER position, steering pointer information (ILS mode) is valid for that particular flight director. If the VOR-TACAN SELECTOR switch is in the SLAVE position, steering pointer information (ILS mode) will not be valid unless the course selected is the same as that course which has been selected on the course indicator of the pilot who controls the flight director display (MASTER position). If the reciprocal of the course is selected, steering pointer information will be invalid.

NOTE

It is possible for both pilot and copilot to receive DME information via their respective course indicators whenever the TACAN function switch is in the T/R position, regardless of the position of either VOR/TACAN-SELECTOR switch.

Course Bar

The course bar (D, figure 11-4) is symbolic of a segment of the selected TACAN/VOR radial or localizer course. The position of the symbolic aircraft with respect to the course bar is always the same as the position of the pilot's helicopter with respect to the selected course.

To/From Arrow

Ambiguity in omni bearing information is resolved by the to/from arrow (E, figure 11-5). The arrow will indicate the direction TO the station along the course line selected with the course arrow.

Miles Counter

The distance to a VORTAC or TACAN station, measured by the aircraft DME equipment, is displayed by the MILES counter (F, figure 11-5). The distance is read in nautical miles.

Glide Slope Pointer

Both the course indicator and the attitude indicator of the AN/AYN-2 have glide slope pointers (G, figure 11-5).

The glide slope pointer on the course indicator also is useful for quick reference when the aircraft is inbound on the localizer to the outer marker; interception of the glide path is readily seen.

HEADING MARKER

The steering pointer guides the pilot to establish the heading read by the heading marker when the mode selector on the attitude indicator is set to the HDG position (H, figure 11-5). The heading marker is read against the azimuth card and is positioned on the card by rotating the HDG knob.

INSTRUMENT AMPLIFIER

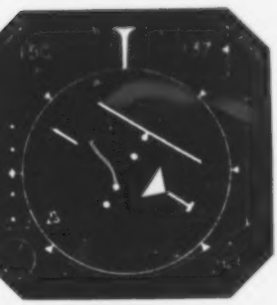
Compass and gyro warning flag circuitry and servo amplifiers for the approach horizon and the course indicator are contained within the instrument amplifier.

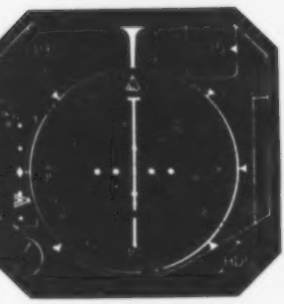
FLIGHT DIRECTOR SPECIFICATIONS

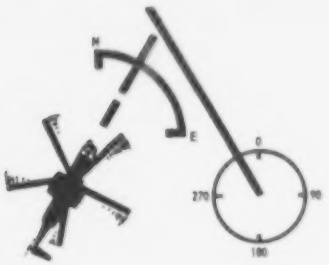
The following ratios have been established for the flight director.

GLIDE SLOPE POINTER

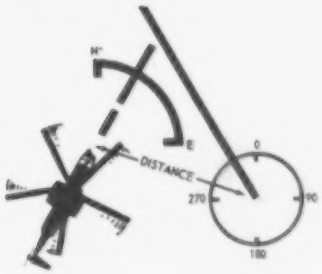
A full scale deflection of the glide slope pointer on the vertical glide slope scale corresponds to an aircraft deviation of 0.5 degree from the glide path.





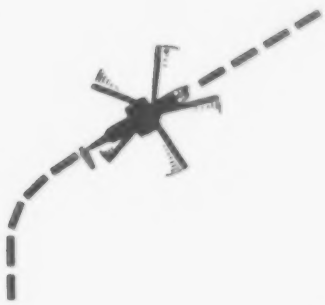


E
TO FROM ARROW



F
MILES COUNTER

G
GLIDE SLOPE POINTER



H
HEADING MARKER

Figure 11-5. - An/AYN-2 course indicator.

PITCH BAR

A one-dot deflection of the pitch bar, measured on the pitch scale, corresponds to an aircraft pitch angle of 5 degrees.

COURSE BAR

When the receiver is tuned to a TACAN/VOR radial, a two-dot deflection of the course bar corresponds to an aircraft deviation of 10 degrees. When the receiver is tuned to a localizer course, a two-dot deflection of the course bar corresponds to an aircraft deviation of 2.5 degrees. The course bar deflection is nonlinear beyond two dots.

HORIZON DISC

The aircraft bank angle divisions on the horizon disc represent 10, 20, 30 and 45 degrees of bank.

PITCH TRIM

One division on the pitch TRIM knob represents five degrees of pitch.

STEERING POINTER

The steering pointer will not direct banks in excess of 15 degrees in any mode.

HDG Mode of Operations

A selected heading error of 10 degrees is equivalent to a bank error of 15 degrees.

ILS (TACAN/VOR And Localizer) Mode Of Operation

A bank angle of 2.2 degrees is equivalent to one degree of course datum.

DEV Mode Of Operation

The steering pointer indicates which way to bank in order to intercept or track a selected course.

FLIGHT DIRECTOR MODES

HDG MODE OF OPERATION

The HDG mode of operation is obtained by setting the attitude indicator mode selector knob to the HDG position. A magnetic heading is selected by rotating the course indicator HDG knob until the heading marker is set to the desired magnetic heading as read on the azimuth card. Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of the azimuth card with respect to the lubber line. Helicopter position, with respect to the selected heading, is given by the position of the heading marker (representing selected heading) with respect to the lubber line (representing the actual helicopter magnetic heading).

Horizontal guidance steering information is displayed by the steering pointer. The steering pointer deflection indicates the amount and direction of bank required to obtain a selected heading. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made into the magnetic heading. Once the helicopter is on the magnetic heading, minor changes in magnetic heading cause the pointer to deflect in the direction which the helicopter must be turned to correct the error.

ILS MODE OF OPERATION

An ILS, TACAN, or VOR mode of operation is obtained by setting the mode selector knob to the ILS position. Align the VOR-TACAN selector switches to desired MASTER/SLAVE positions.

When the navigation receiver is tuned to a localizer frequency, the reference pitch attitude (the pitch attitude required to maintain descent on the glide path) is preset by an adjustment made during test bench adjustments. The pitch bar will be automatically positioned with respect to this reference each time the mode selector knob is set to ILS. The inbound localizer course is obtained by tuning the VOR receiver to the proper localizer frequency. The COURSE knob is rotated until the course counter indicates the heading of the inbound localizer course. Helicopter position, with respect to the localizer course, is presented by the course bar.

The GS warning flags will unmask the glide slope pointers when the glide slope receiver is tuned to a signal of sufficient strength and the glide slope signal is presented. Helicopter position, with respect to the glide path, is presented by the attitude indicator and course indicator glide slope pointers. A TACAN or VOR radial may be selected for use with the course indicator by tuning the associated navigation receiver to the desired TACAN or VOR facility and rotating the COURSE knob until the COURSE counter indicates the desired radial on the azimuth card. The pilot should make the TACAN or VOR course intercept in the HDG mode, switching to the ILS mode once the course has been intercepted. Helicopter position, with respect to the selected TACAN or VOR radial, is presented by the course bar. Helicopter pitch attitude is displayed by the

pitch bar. Helicopter bank attitude is displayed by the horizon disc as in the HDG mode of operation. The horizontal guidance steering signal, with crosswind correction, is displayed by the pointer. The steering pointer deflection indicates the amount and direction of bank required to fly a localizer heading. When the helicopter is banked in the proper direction to center the steering pointer and sufficient rudder is applied for a coordinated turn, a smooth entry will be made onto the localizer or selected course. Once the helicopter has obtained the localizer or selected course, minor changes cause the steering pointer to deflect in the direction in which the aircraft must be banked to correct the error.

NOTE

Steering pointer commands, in the ILS mode, are at times erratic, overly sensitive and contradictory to the information displayed by the course indicator. This phenomenon is most prevalent when the system is used in proximity to the radio navigational aid. The flight director steering pointer should not be used in the ILS mode during an instrument approach, departure, or other conditions of instrument flight requiring high levels of pilot concentration.

NOTE

The VOR/TACAN selector switches must be aligned to desired MASTER/SLAVE positions before the desired navigational aid is used. In the ILS mode, in order for the pilot to interpret a selected TACAN course with the steering pointer and to provide a correct pictorial plan view, the pilot's and copilot's course counters must display the same selected course.

DEV MODE OF OPERATION

The DEV mode of operation is obtained by setting the attitude indicator mode selector knob to the DEV position. A reference pitch attitude is obtained by setting the pitch TRIM knob to the desired pitch attitude. A TACAN or VOR radial is selected by tuning the associated navigation receiver to the desired TACAN or VOR facility, aligning the VOR-TACAN selector switches to desired MASTER/SLAVE positions, and rotating the COURSE knob until the COURSE counter indicates the desired course.

Helicopter pitch attitude, with respect to the reference pitch attitude, is displayed by the pitch bar. Helicopter bank attitude, with respect to the horizon, is displayed by the horizon disc. Helicopter magnetic heading is displayed by the position of the azimuth card with respect to the lubber line. A display of helicopter position, with respect to the selected TACAN or VOR course selected, is presented by the course bar. While the flight director is in the DEV mode of operation, the steering pointer receives information directly from the selected navigation receiver and indicates which way to turn in order to intercept or track a selected course. The steering pointer does not indicate the amount of bank required. Warning flag services are provided as in the HDG mode of operation.

OFF MODE OF OPERATION

When the flight director is in the OFF mode, the steering computer is deactivated, and the steering pointer and steering flag on the attitude indicator is biased out of view. In all other respects, the OFF mode operates the same as the DEV mode.

FLIGHT DIRECTOR OPERATION

PREFLIGHT CHECKLIST

1. Adjust the pitch trim knob to the center index on the pitch trim scale; then check to see that the positions of the pitch bar and horizon bar correspond to the actual attitude of the helicopter.

2. Check to see that the helicopter heading corresponds to the heading read on the azimuth card.

3. Tune the helicopter TACAN or VOR receiver to a TACAN or VOR station. Set the mode selector to the DEV position. Set the course arrow to the radial on which the aircraft is located. The course bar and the steering pointer should center.

4. Move the course arrow 10° to the right or left. The course bar and steering pointer should both be deflected in appropriate directions. The course bar should be deflected to the outer dot.

5. Set the mode selector to the ILS position. The steering pointer should call for a bank toward the selected course.

6. Move the course arrow to a position which centers the course bar. The steering pointer should come to rest centered.

7. Tune the helicopter VOR receiver to the localizer. Set the course arrow to the inbound localizer front course. The course bar should be deflected in a direction appropriate to the location of the localizer. The steering pointer should call for a bank toward the localizer.

8. Set the mode selector to the OFF position. The STEERING flag and the steering pointer should both be hidden from view.

9. Set the mode selector to the HDG position. Set the heading marker under the lubber line. The steering pointer should come to rest centered.

10. Move the heading marker to the left. The steering pointer should be deflected to the left.

AFCS ACCELEROMETER CHECK

This check should be accomplished if usage of the AFCS coupler is anticipated.

1. Place the meter selector on the CHANNEL MONITOR panel to the CPLR position.

2. Set the MODE selector on the AFCS indicator to the A MODE.

3. Place the DOPPLER in STANDBY.

4. Put the Altitude Set Pot on the AFCS CONTROL PANEL to 0. (zero)

5. Push the AFCS Button on the AFCS Control Panel to engage the AFCS.

Locate the deadbank/null area on the drift pot by setting the knob to the full counterclockwise position. Slowly rotate the drift pot clockwise, noting that the roll bar on the AFCS indicator will follow the movement of the drift pot until the dead/bank null area is reached. The roll bar and the drift pot should both be centered. If the roll bar is not centered within the donut, adjust the associated accelerometer null set screws to obtain proper alignment within the donut. Repeat the same procedure for the speed pot.

Check the vertical accelerometer by noting the position of the vertical pointer. Alignment should be within ± .25 of a division from the center. If it is not, adjust the appropriate accelerometer null set screw to obtain proper alignment.

If the altitude or cyclic coupler checks are not going to be accomplished, place the meter selector switch to ASE and disengage the AFCS.

SELF-QUIZ # 11

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. The horizontal guidance signal is displayed on the attitude indicator of the flight director system by means of the _____.

A. horizon disc
B. steering pointer
C. pitch bar display
D. glide slope pointer

2. Any malfunction in the glide slope system is indicated by a/an _____.

A. amber light
B. green light
C. buzzing signal
D. warning flag

3. The AN/AYN-2 steering flag is displayed, regardless of the mode switch position, when the _____ fails.

A. radio input
B. directional gyro
C. remote indicating compass
D. steering computer primary power

4. The pitch bar trim is preset when the mode selector is in the _____ position.

A. OFF
B. ILS
C. HDG
D. DEV

5. The helicopter heading will be accurately shown under the _____ on the AN/AYN-2 course indicator.

A. lubber line
B. azimuth card
C. course arrow
D. heading marker

6. TACAN information will automatically be displayed on the copilots' flight director system when there is a power failure to the _____ receiver.

A. DF-301
B. UHF COMM
C. VHF NAV
D. LF/ADF

7. The heading marker is read against the azimuth card and is positioned on the card by rotating the _____.

A. course knob
B. heading knob
C. heading marker
D. glide slope pointer

8. When the receiver is tuned to a localizer course, a two-dot deflection of the flight director course bar corresponds to an aircraft deviation of _____ degrees.

A. 1.5
B. 2.0
C. 2.5
D. 3.0

9. An ILS, TACAN, or VOR mode of operation is obtained by setting the mode selector knob to the _____ position.

A. ILS
B. VOR
C. TACAN
D. MASTER

10. During an instrument approach, the flight director steering pointer should not be used in the _____ mode.

A. OVR
B. ILS
C. DEV
D. ADF

ANSWERS TO SELF-QUIZ # 11

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	B	11-2
2	D	11-2
3	D	11-2
4	B	11-2
5	A	11-4
6	C	11-6
7	B	11-6
8	C	11-8
9	A	11-8
10	B	11-9

Reading Assignment:
Pages 12-1 through 12-9.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the radar altimeter system.
2. Summarize the operation of the radar set.

RADAR ALTIMETER AN/APN-171(V)

Radar altimeter set AN/APN-171(V) consists of a receiver-transmitter, two indicators, and two antennas. The set provides instantaneous indication of actual clearance between the helicopter and terrain from 0 to 5,000 feet with the following accuracies:

Altitude (ft)	Accuracies
0-200	± (3ft. + 2% of altitude)
200-1000	± (7ft. + 2% of altitude)
1000-5000	± (25ft. + 2% of altitude)

Altitude, in feet, is indicated by the radar altimeter indicators (figure 12-1) located on the pilot's and copilot's instrument panel. The radar altimeter is powered by the DC primay bus and the No. 1 AC primary bus. Both the DC and AC circuits are protected by circuit breakers on the copilot's circuit breaker panel. One circuit breaker is marked RDR ALTM under the general heading DC PRI. The other circuit breaker is marked RDR ALTM 0A under the general heading NO. 1 AC PRI.

Figure 12-1. - Radar altimeter AN/APN-171(V).

RADAR ALTIMETER OPERATION

A control knob, located on the lower left corner of the indicator, combines functions to serve as a test switch, a low level warning index set control, and an on/off power switch. The system is turned on by rotating the control knob, marked PUSH-TO-TEST, clockwise from the OFF position and is the only control necessary for equipment operation. Three minutes must be allowed for system warmup. Both control knobs must be in the OFF position to secure the set. Continued clockwise rotation of the control knob toward the SET position will permit each pilot to select any desired low-altitude limit, which will be indicated by the low-level warning index marker (bug) on the indicator. A low-level warning light, located on the lower right-hand corner of the indicator, will illuminate and show the marking LOW any time the helicopter is at or below the low-altitude limit that has been selected. On helicopters modified by T.O. 1H-3(H)F-570, the low limit warning light can be dimmed by using the dimming switch for the Caution/Advisory panel.

NOTE

Rheostat marked PILOT FLT INST on the overhead switch panel must be ON to use the bright/dim switch.

Depressing the PUSH-TO-TEST control switch provides a testing feature of the system at any time and altitude, provided the RAD ALT mode of the AFCS is disengaged. When the PUSH-TO-TEST control knob is depressed, a visual indication of 100 ± 15 feet on the indicator is indicative of satisfactory system operation. Releasing the PUSH-TO-TEST control knob restores the system to normal operation. In addition to altitude measurement, the altimeter provides outputs to the coupler for RADALT HOLD operation.

RADAR ALTIMETER WARNING SYSTEM (RAWS)

Three audio warning signals are developed by the altimeter and are fed into the pilot's and copilot's headsets. The first is a 1,000-Hz steady tone which sounds when the altimeter is unreliable. At approximately 200 feet, a 1,000-Hz tone is switched on for 3 seconds and is pulsed at a rate of two pulses per second. At 50 feet, this tone is again switched on for 3 seconds but is pulsed at a rate of four pulses per second. A two-position switch on the instrument panel, marked ON and OFF, under the heading RAWS (figure 12-2) turns the RAWS system on and off. When the switch is in the OFF position, an amber light on the caution advisory panel, marked RAWS OFF, is illuminated.

Figure 12-2. - Radar altimeter warning system (RAWS) selector switch.

Failure Indications

Loss of system power or tracking condition will be indicated by a black and yellow striped flag which appears in the indicator window on the lower center portion of the indicator. If the system should become unreliable, the black and yellow striped flag will appear, the indicator pointer will go behind a mask, marked NO TRACK, to prevent erroneous readings, and a 1,000 Hz audio tone will sound in both pilot's ICS. If the coupler RAD ALT hold mode is engaged at this time, it will disengage. During normal flight operations, it is not necessary to turn the system off when the aircraft is operating above 5,000 feet.

NOTE

IF AC power is lost, the pointers freeze in position. An audio warning will be heard on the ICS if AC power is lost and the RAWS switch is ON.

RADAR SET AN/APN-195

The AN/APN-195 radar set is a lightweight, pulse-modulated radar system consisting of a receiver-transmitter, synchronizer, control panel, indicator, and antenna. This set provides an accurate and continuous picture of weather conditions (weather map) in the general sky area ahead of the helicopter and is used as a navigation and search aid to extend the vision of the pilot. The AN/APN-195 is powered by the No. 1 AC primary bus and is protected by a circuit breaker on the copilot's circuit breaker panel. The circuit breaker is marked SEARCH RADAR under the general heading NO. 1 AC PRI. In addition, pitch and roll inputs from the A/A24G-39 are necessary to stabilize the antenna.

RADAR SET CONTROL PANEL

The control panel and azimuth range indicator (figure 12-3) are centrally located on the instrument panel and are accessible to both pilots. The control panel contains three controls: a mode selector switch, a receiver gain control, and an antenna tilt control.

Mode Selector

The mode selector switch is a rotary four-position switch marked OFF-STBY-OPR-CTR. The OFF position disconnects power from the radar set. The STBY position applies voltage to tube filaments and initates an approximate four-minute time delay for

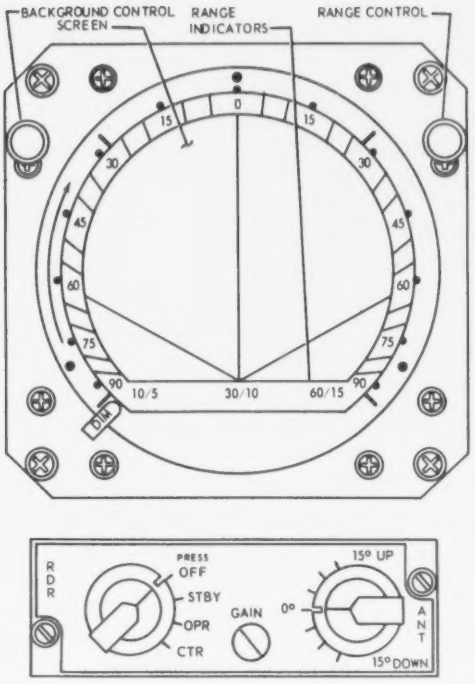


Figure 12-3. - Radar set AN/APN-195.

warm-up. It also holds the equipment in standby condition after the four-minute time delay expires. The OPR position applies voltage to all circuits (after elapse of four-minute time delay) for normal operation. The radar echo from the target area is displayed on the azimuth-range indicator screen as bright spots or areas. The contour circuit is inoperative. When the switch is in the CTR position, areas of heavy rainfall are displayed on the azimuth range indicator screen as dark areas or black holes surrounded by bright rings which represent areas of lighter rainfall.

CAUTION

There is a detent between the OFF and STBY positions to prevent accidental shutdown of the radar with a subsequent recycled four-minute delay. To overcome this when shutting off the system, depress the mode selector switch (pushed into the control panel) when going from the STBY to the OFF position. Deviation from this procedure will result in a broken switch which will indicate OFF when actually in the STBY position, STBY when in the OPR position, the OPR in the CTR position.

Receiver Gain Control

The receiver gain control, marked RECEIVER GAIN, controls the amplification of the radar echo received.

Antenna Tilt Control

The antenna tilt control, marked ANT, is a synchro control marked UP and DOWN at 5° intervals. The control varies the tilt of the antenna reflector between 15 degrees above (UP) and 15 degrees below (DOWN) the horizontal reference plane of the helicopter.

Azimuth-Range Indicator

The azimuth-range indicator contains a screen that displays target echoes, a range switch, a background control, and a dimming control. The screen indicates the range and azimuth of targets.

The unmarked range switch is located in the upper right side of the indicator and is a three-position rotary switch. The range switch, when rotated fully counterclockwise to the first position, will illuminate an indicator, marked 10/5 at the base of the screen. This position provides a 10-mile sweep trace and two 5-mile range circles on the screen. The second clockwise position on the rotary switch will illuminate an indicator, marked 30/10 at the base of the screen. This position provides a 30-mile sweep trace and three 10-mile range circles on the screen. The third clockwise position on the rotary switch will illuminate an indicator at the base of the screen, marked 60/15. This position provides a 60-mile sweep trace and four 15-mile range circles on the screen. All distance references are in nautical miles. The unmarked background control located in the upper left side of the indicator is in the minimum intensity position when rotated fully counterclockwise. The background control adjusts the level of background noise to permit very weak echoes to be viewed on the screen. The dimming control, marked DIM, revolves on the periphery of the screen and is used to dim the display for best viewing. The dimming control is off when revolved fully counterclockwise (down).

RADAR OPERATION

Preliminary Operating Procedures:

1. Mode Selector Switch - OFF.
2. Antenna Tilt Control - CENTERED (0).
3. Receiver Gain Control - FULLY COUNTERCLOCKWISE.

4. Range Switch - 60/15.

5. Background Control - FULLY COUNTERCLOCKWISE.

6. Dim Control - FULLY COUNTERCLOCKWISE (down).

STARTING

1. Mode Selector Switch - OPR.

NOTE

The equipment will not function for 4 minutes because of a built-in automatic time delay.

---

2. Range Switch - 30/10.

3. Background Control - AS REQUIRED.

Adjust background control until scope becomes green. Then turn counterclockwise until green just disappears (range marks will still be visible).

4. Receiver Gain Control - AS REQUIRED.

5. Background Control - AS REQUIRED.

6. Dim Control - AS REQUIRED.

7. Range Switch - AS REQUIRED.

8. Antenna Tilt Control - ADJUST FOR TARGETS.

Turn the tilt control slowly (approximately 1° per second) when adjusting for small targets, such as ships.

Weather Observations
(See figures 12-4 and 12-5.)
Perform the preliminary operating procedures:

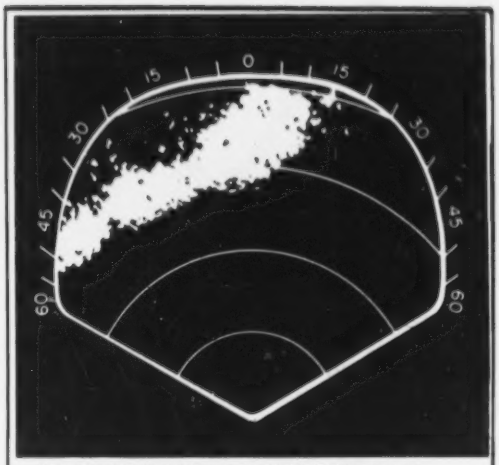
1. Antenna Tilt Control - AS REQUIRED.

2. Mode Selector Switch - OPR.

3. Receiver Gain Control - AS REQUIRED.

4. Range Switch - AS REQUIRED.

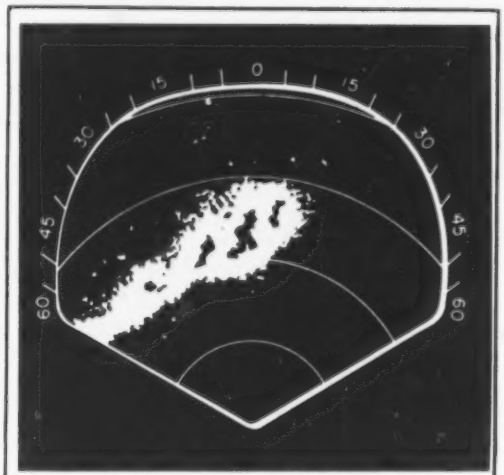
5. Mode Selector Switch - OPR/CTR AS REQUIRED.



THE RANGE SWITCH IS NOW IN THE 60 '15 POSITION. THE MASTER SWITCH IS IN THE OPR POSITION. THE CLOSEST PORTION OF THE FRONT IS DISPLAYED APPROXIMATELY 30 DEGREES LEFT OF THE 0-DEGREE REFERENCE AT THE DISTANCE OF APPROXIMATELY 40 NAUTICAL MILES.

THE EXTENT IN AZIMUTH OF AN ACTIVE, TURBULENT STORM IS SHOWN IN THIS DISPLAY; HOWEVER, NO INFORMATION RELATIVE TO AREAS OF HEAVY TURBULENCE OR RAINFALL GRADIENTS IS OBTAINABLE. AN AIRCRAFT MAY BE FLOWN AROUND THIS FRONT BY AVOIDING AREAS OF INTENSE ECHOES. S 8639 C1

Figure 12-4. - Weather interpretation (OPR) position.



THE RANGE SWITCH IS STILL IN THE 60 '15 POSITION, HOWEVER, THE MASTER SWITCH IS NOW IN THE CTR POSITION. THIS DISPLAY SHOWS AREAS OF HEAVY TURBULENCE. AN AREA OF HEAVY RAINFALL IS DISPLAYED AT 0 DEGREES 35 NAUTICAL MILES. SMALLER AREAS OF LIGHT RAINFALL ARE SHOWN AT 15 DEGREES LEFT OF THE 0-DEGREE REFERENCE AND 35 DEGREES LEFT OF THE 0-DEGREE REFERENCE AT A RANGE OF APPROXIMATELY 30 NAUTICAL MILES.

THE RAPID CHANGE FROM BRIGHT TO DARK AT THE 0-DEGREE REFERENCE POSITION INDICATES EXTREME TURBULENCE IN THE AREA AROUND THE CONTOUR OF THE BLACK HOLE. THE RAIN GRADIENTS AT 15 DEGREES LEFT OF CENTER ARE NOT STEEP, TURBULENCE MAY EXIST AT THIS POSITION, BUT IT IS NOT AS EXTREME AS AT THE 0-DEGREE POSITION. S 8640 C1

Figure 12-5. - Weather interpretation (CTR) position.

SELF-QUIZ # 12

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. At an altitude of 200 to 1,000 feet, the accuracy of the radar altimeter is _____ of indicated altitude.

A. ± 3 ft. + 2%
B. ± 3 ft. - 2%
C. ± 7 ft. + 2%
D. ± 7 ft. - 2%

2. The radar altimeter warning system will produce a 1,000-Hz steady tone when the _____.

A. aircraft is at 200 ft.
B. altimeter is unreliable
C. aircraft is at 50 ft.
D. RAWS system is first turned on

3. What is the approximate warm-up time delay for the AN/APN-195 radar set?

A. 30 seconds
B. 90 seconds
C. 2 minutes
D. 4 minutes

4. The range switch in the azimuth-range indicator is located in the _____ side of the indicator.

A. upper right
B. upper left
C. lower right
D. lower left

ANSWERS TO SELF-QUIZ # 12

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	C	12-1
2	B	12-2
3	D	12-2
4	A	12-3

Reading Assignment:
Pages 13-1 through 13-6.

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Describe the procedures for establishing and maintaining airborne communications.
2. Explain the radio frequency procedures used to establish contact with a surface or air unit.
3. Summarize the procedures for sending aircraft message reports.
4. Describe the aircraft communications equipment used in aircraft, small boats, and sea going vessels.

AIRCRAFT COMMUNICATIONS IN ACCORDANCE WITH COMMUNICATIONS MANUAL (M2000.3A)

ESTABLISHING COMMUNICATIONS

Aircraft normally establish communications on a prearranged frequency with their aeronautical station within 5 minutes after take off. The station so contacted will then be responsible for the radio guard of the aircraft until it returns or until another station has established communications with the aircraft and has assumed radio guard responsibility.

NOTE

An aeronautical station is a land station in the aeronautical mobile service which includes a communication/radio station with an air-ground position. In certain instances an aeronautical station may be placed on board a ship.

IN FLIGHT COMMUNICATIONS

Operations permitting, all Coast Guard aircraft will guard the emergency frequencies 121.5, 156.8, and 243.0 MHz. Appropriate VHF/UHF frequencies are used for all normal communications, and use of 121.5, 156.8 and 243.0 MHz is restricted to emergency communications or circumstances where other frequencies will not suffice.

Aircraft in flight shall establish communication contact with an aeronautical station as follows:

Fixed Wing

An operations normal report at least every thirty (30) minutes and a position report at least every sixty (60) minutes.

Helicopters

An operations normal report at least every fifteen (15) minutes and a position report at least every thirty (30) minutes. If an aeronautical station loses contact with an aircraft, it shall be the responsibility of such aeronautical station to initiate the necessary action to re-establish communications with the aircraft directly or through another station or to initiate an alert. (Any communication with an aircraft will serve to begin a new 30/15 minute period for the purpose of making an "operations normal" report.) When operating under the conditions specified below, aircraft in flight are specifically exempted from establishing communications with an aeronautical station.

1. When the pilot in command is maintaining communications with ATC facilities, he makes the required position reports to the ARTC OR OATC with which he holds communication contact. He should shift his communication guard to the appropriate ATC facility.

2. When the pilot in command is maintaining communications with an on-scene commander (OCS) in conjunction with a mission, the pilot makes the required position reports to the OSC. An aircraft engaged in a SAR mission and reporting to an on-scene commander should shift its communication guard from the aeronautical station to the OSC until released from the SAR mission for return to base. In flight, SAR communications are conducted in accordance with section 1830, M2000.3A

3. When the proper authority has instructed the pilot in command to maintain radio silence, the requirement for communication contact with an aeronautical radio station is waived. In any case of contemplated radio silence, the radio station is so advised and radio contact reestablished as soon as practicable thereafter.

As a general rule, the primary channel for operation communications between the operational commander and his aircraft is through Coast Guard facilities. Relay through the facilities of other agencies is authorized when operationally necessary.

Contact Frequencies

UHF air/surface frequencies are used to the fullest extent possible for short range communications. Aircraft may use Coast Guard VHF/FM maritime mobile frequencies when operating with Coast Guard small boats or group commanders. HF air/surface frequencies are used when line-of-sight communications are not possible. Air station operation/communication centers can be contacted on one or the other of the Coast Guard UHF common frequencies 381.8 or 383.9 MHz during hours of air station operations. In addition to the above UHF frequencies, air stations can be contacted during times of operation on the appropriate HF air/surface frequencies listed under circuits E1 or E2 in CG-233-1. When required, HF air/surface frequencies can be remoted to the air station operations center. Coast Guard air traffic control towers guard the frequencies listed under circuit E5 in CG-233-1. The frequencies actually guarded by a particular air station may be determined by referring to the DOD Flight Information Publication Enroute Supplements.

When an aircraft is communicating with a district radio station that is maintaining radio guard for an air station, the frequencies used are those from circuits E1, E2, and J1.2 in CG-233-1 which are appropriate. In such cases, the district radio station is called by its own radio call sign and not that of the air station. Traffic so passed to a radio station for delivery to an air station will contain proper routing instructions in the transmission instructions.

Communications required for Oceanic Air Traffic Control (OATC) clearance normally will be conducted between aircraft and the ICAO aeronautical station serving the oceanic area control center on the voice or CW frequencies provided for this purpose.

CG aircraft may use any aeronautical mobile (R) band frequency for communications with aeronautical stations regularly serving the routes or areas to which these frequencies are allotted. In certain areas Aeronautical Radio Incorporated (ARINC) operates the ICAO aeronautical stations. In these areas, aircraft should make every effort to use government facilities rather than those of ARINC, provided government facilities can serve the air traffic control requirements.

Call Signs

Call signs for aircraft will be in accordance with ACP 125 and its supplements for voice and USN Suppl-1 to ACP 110 for CW. For training, logistic flights, and peacetime operational missions, use the international call signs. Use the entire aircraft number in forming the call sign. After the initial call-up, the voice call sign may be abbreviated. Examples of international call signs are shown below:

Aircraft	Voice Call Sign	CW Call Sign
HU-65A 1242	Coast Guard 1242	Not applicable
HC-130B 1340	Coast Guard 1340	NC 1340
HH-3F 1469	Coast Guard Copter 1469	Not applicable

All aircraft on search and rescue missions will insert the word "RESCUE" in the call sign after COAST GUARD when using voice procedure.

PROCEDURE FOR CALLING SHORE STATIONS

Aircraft and units afloat may call aeronautical stations or shore facilities by using the station or field name followed by AIR, TOWER, RADIO, COMSTA, or other appropriate voice procedures.

Examples: KODIAK AIR - ELIZABETH CITY TOWER - MIAMI RADIO - HONOLULU COMSTA

AIRCRAFT MESSAGE REPORTS

General

Types of aircraft message reports:

1. Departure
2. Arrival
3. Weather
4. Rendezvous with ship
5. SITREP
6. Prospective flight notices

7. Remaining overnight
8. Accident
9. Ferry movement
10. Pollution reports
11. Fisheries patrol reports

Aircraft message reports may be via the following communication services:

a. Coast Guard
b. Navy
c. Air Force
d. Army
e. Federal Aviation Administration
f. ICAO
g. Commercial

Air traffic control communications will be handled in accordance with procedures set forth by the FAA and ICAO where applicable.

Procedure

Normally aircraft movement message reports are sent IMMEDIATE precedence (O) to action addressees. Reports to information addressees, in most cases, may be sent with a lower precedence.

Responsibility For Filing

Responsibility for filing departure and arrival reports rests solely with the pilot in command, except when the point of departure or arrival is a unit under Coast Guard jurisdiction. In this case the responsibility rests with the commanding officer of the unit. In the latter event, the pilot in command ensures that the commanding officer of such ship or station is properly notified as to the movement, departure, or arrival.

Departure Reports

On certain flights, message reports are required to keep appropriate commands informed of the type and Coast Guard number of the aircraft, pilot's name, names and titles of passengers of high rank, point of departure, destination, ETA, and nature of mission. The pilot in command files messages giving pertinent information concerning these flights in accordance with existing area and district directives.

When flights are made outside the home district, district commanders (and other appropriate commands) concerned are included as information addressees. Flights of this type are:

1. Operational flights (except ferry).

2. Training flights which involve a remaining overnight report (RON).

3. Training flights where stops are made and the locations and/or circumstances indicate that the district commander should be informed.

Examples:

AIRCRAFT MOVEMENT

```
0 181328Z AUG 80
FM COGARD AIRSTA NEW ORLEANS LA
TO COGARD AIRSTA MIAMI FL
INFO CCGD EIGHT NEW ORLEANS LA
BT
UNCLAS
SUBJ: AIRCRAFT MOVEMENT
1. HH-3F CG 1433 LCDR CARTER NEW ORLEANS FOR MIAMI.
2. ETA 2250Z
BT
```

LOGISTICS

```
0 200249Z AUG 80
FM COGARD ONE FOUR THREE THREE
TO COGARD AIRSTA NEW ORLEANS LA
INFO CCGD EIGHT NEW ORLEANS LA
COGARD AIRSTA HOUSTON TX
BT
UNCLAS
SUBJ: HOUSTON LOGISTICS
1. HH-3F CG 1433 LCDR ANGUS HOUSTON FOR NEW ORLEANS 0244Z.
2. ETA 0705Z
3. RADM STARBOARD PLUS TWO
4. REQUEST TRANSPORTATION
BT
```

TRAINING

```
0 031433Z SEP 80
FM COGARD AIRSTA NEW ORLEANS LA
TO USCGC PREVELANT
INFO CCGD EIGHT NEW ORLEANS LA
BT
UNCLAS
SUBJ: SAREX USCGC PREVELANT
A. CCGD EIGHT 020905Z SEP 80
1. HH-3F CG 1433 LT LOCKNESS DEPT 1401Z.
2. ETA USCGC PREVELANT, POSIT 30-51N 91-12W 1452Z.
BT
```

Arrival Reports

After completing a flight on which a departure report was sent, an aircraft or unit will make an arrival report. It should be addressed to the controlling Coast Guard activity and the addressees of the departure message.

Weather Reports

Aircraft make weather reports as directed by the officer authorizing the flight. When the officer ordering the flight so directs, or authorizes, position reports and weather reports may be combined in one report.

Rendezvous With A Coast Guard Or Navy Ship

Before departing from a shore station or as soon thereafter as practicable, an aircraft sends a message to the ship of destination as follows:

Action addressee:

1. Ship of destination

Information addressees:

1. District Commander
2. Other activities assisting in the operation
3. Appropriate addressees

Contents:

1. Model designation and Coast Guard number of aircraft
2. Aircraft commander's name and rank
3. Estimated time of departure
4. Estimated time of arrival at ship
5. True airspeed and altitude
6. Aircraft/ship calling frequency
7. Special requests, such as for weather

Operations Normal Report

Helicopters in flight are required to contact an aeronautical station at least every fifteen (15) minutes for an operations normal report and at least every thirty (30) minutes to give position and operations normal report..

Situation Reports (SITREP)

The operational commander specifies the form, content, and requirements for situation reports.

Example Format:

SITREP

0 150147Z SEP 80
FM COGARD ONE FOUR THREE THREE
TO NEW ORLEANS SARCOORD NEW ORLEANS LA
INFO COGARD AIRSTA NEW ORLEANS LA
BT
UNCLAS
ALERT SITREP TWO F/V DRIFTER OVER DUE
1. SITUATION:
   A. 0105Z HH-3F CG 1433 ON SCENE
   B. WEATHER CAVU SEAS 3 TO 5 WIND 240/12
2. ACTION:
   A. CONDUCTING SHORE LINE SEARCH PT. CHEVREUIL TO NORTH PT.
3. PLANS:
   A. PLAN SEARCH OF POINT AU FAR ISLAND ON RETURN NEW ORLEANS
4. RECOMMENDATIONS:
   A. REQUEST HARBOR CHECK OF WEEKS BAY BY LOCAL AUTHORITIES
*5. CASE PENDS:
BT

*SAR Coordinators assign the CASE STATUS. CASE CLOSED can only be sent by the SAR Coordinator.

Prospective Flight Notices

Prospective flight notices are sent only when it is necessary to make prior arrangements, request special services, or inform aeronautical stations of frequency plan and/or aircraft calls. Prospective flight reports carry precedence and classification according to the requirements.

RON Reports

Remaining overnight (RON) reports may be filed as an additional group of the contents of an arrived report. Include only the abbreviation RON.

Accident Reports

The U.S. Coast Guard Safety Manual (CG-405) contains instructions for message reports of aircraft or ground accidents and for preliminary reports of aircraft accidents.

Ferry Movement Reports

These reports are sent in accordance with the Air Operations Manual, M2000.3A

TYPICAL RADIO COMMUNICATIONS APPLICABLE TO THE HH-3F

Before flight, an aircraft normally makes an initial radio communications check on HF (high frequency) equipment with the aeronautical station responsible for the aircraft radio guard. At this time, the aeronautical station provides the aircraft with the correct time of day and the quality of the aircraft HF transmission. Primary and secondary frequencies to be used during the flight are passed to the aircraft at this time also.

NOTE

The secondary frequency assigned is used if communications between the aircraft and the aeronautical station are lost at any time during the flight.

Any difficulty in obtaining this initial contact with the aeronautical station should be brought to the attention of the aircraft commander immediately for possible corrective action before flight.

After takeoff, the aircraft passes the airborne time to the aeronautical station, along with the number of persons on board (POB) and the purpose or destination of the flight.

At the nearest quarter hour, the aircraft passes a "flight operations" report to the aeronautical station. This report informs the aeronautical station of in-flight aircraft and aeronautical station. At the next quarter hour, the aircraft gives a position report along with the "flight operations" report. From this time until the end of the flight, a "flight operations" report is given every 15 minutes along with a position report every 30 minutes.

Before securing at the end of the flight, the aircraft must inform the aeronautical station of flight termination. The aeronautical station then terminates radio guard with the aircraft without further effort to contact the aircraft.

COMMUNICATION LOGS

Three significant terms used in this discussion are defined below:

1. RADIO LOG: An official record of signals transmitted and received by a radio-equipped unit.

2. COMPLETE RADIO LOG: A complete and continuous record of all signals transmitted and received.

3. ABBREVIATED RADIO LOG: A complete record of all transmitted and received signals that pertain to the unit such as incoming messages, weather, radio checks, etc.

Radio logs provide a record of radio transmissions and receptions to aid units in recounting past actions. All radio transmissions pertaining to a unit's operations should be logged. However, keeping radio logs aboard some type of Coast Guard units is impractical; such logs may be inaccurate or incomplete and thus of questionable benefit. Tape recordings of radio circuits are considered to be a substitute for a written log.

Radio logs are not required on HH-3F aircraft except when the aircraft are serving as "on-scene-commanders." When serving in this capacity, an abbreviated radio log will be maintained.

A typical abbreviated radio log includes the following:

1. Aircraft model and number.
2. Aircraft crew list.
3. Date.
4. Complete record of messages sent and received.
5. Time of each entry. (GMT or local time may be used)
6. Transmission frequency.
7. Rate and signature of person keeping log.

A new log book page will be used for each flight. All entries will be made in ink. Errors will be corrected by drawing a straight line through the entry and initialing the error.

The completeness of coverage and degree of radio log detail will vary with the type of unit, availability of personnel, and the type of information passing through the unit. The ultimate decisions as to the completeness of the abbreviated radio log rests with the commanding officer.

SAMPLE ABBREVIATED LOG:

CDR TIFFT	HH-3F 1433	AEI FLINT	ATI AARON
LT BUMPS	1 JAN 1981		
	LOCAL TRAINING:		
1602Z	NEW ORLEANS COMSTA TI 1433 RDO CK/LOUD AND CLR		5006
09	NO TI 33 ABNE 08 LOCAL TRAINING/R PRI 56 SEC 89		5006
30	NO TI 33 OPS NORM/R		5006
1701Z	NO TI 33 OPS NORM POSIT SLIDELL/R		5006
29	NO TI 33 OPS NORM/R		5006
57	NO TI 33 LANDING NEW ORLEANS IN 5/R		5006
1805Z	NO TI 33 ON DECK SECURING/R		5006
1807Z	(CHOX)		
2.0	T.F.T (total flight time)		

ATI ARBON
(signature)

SELF-QUIZ # 13

PLEASE NOTE: Many students study ONLY the self-quizzes and pamphlet review quiz, thinking that this will be enough to pass the End-of-Course Test. THIS IS NOT TRUE. The End-of-Course Test is based on the stated course objectives. To pass the EOCT, you must study all the course material.

1. After takeoff, aircraft should contact their aeronautical station within _____ minutes.

A. 1
B. 2
C. 3
D. 5

2. What is one of the emergency communications frequencies?

A. 121.5 MHz
B. 218.2 MHz
C. 256.0 MHz
D. 381.8 MHz

3. When an aircraft is maintaining communications with an on-scene-commander (OSC), the aircraft makes the required position reports to _____.

A. the station to which the aircraft is attached
B. the on-scene-commander
C. any unit with which contact can be established
D. the aeronautical station with which the aircraft is maintaining communications

4. The frequencies actually guarded by a particular air station may be determined by referring to _____.

A. ACP-125
B. CG-233-1
C. the USN/ACP 110 SUPPLEMENT-1
D. the DOD Flight Enroute-Supplement

5. Aircraft movement message reports are normally sent to action addressees with a/an _____ precedence.

A. URGENT
B. ROUTINE
C. PRIORITY
D. IMMEDIATE

6. When an aircraft is sending a message report for rendezvous with a ship, what is contained in the message?

1. True airspeed
2. Estimated time of departure
3. Estimated time of arrival
4. Number of persons on board
5. Estimated time on scene

A. 1, 2, and 4 only
B. 1, 3, and 5 only
C. 1, 2, and 3 only
D. 2, 3, 4, and 5

7. When an aircraft is serving as an "on-scene-commander," what type of radio log should you maintain?

A. Coded
B. Formal
C. Complete
D. Abbreviated

ANSWERS TO SELF-QUIZ # 13

Following are the correct answers and references to the text pages which cover each question and correct answer. To be sure you understand the answers to those questions you missed, you should restudy the referenced portions of the text.

QUESTION	ANSWER	REF.
1	D	13-1
2	A	13-1
3	B	13-1
4	D	13-2
5	D	13-3
6	C	13-4
7	D	13-6

U.S. Department
of Transportation
**United States
Coast Guard**

HH-3F FLIGHT PREPARATION

U.S Coast Guard Institute
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Oklahoma City, OK 73169-6999

FTS: 749-2138

QUESTIONS ABOUT THIS TEXT SHOULD BE ADDRESSED
TO THE AIRCREW SUBJECT MATTER SPECIALIST.

REFERENCES

GOVERNMENT PUBLICATIONS

Flight Manual, U.S. Coast Guard Model HH-3F Helicopters (T.O. 1H-3(H)F-1) 8 July 1982 Change 5, January 1986

Technical Manual, U.S. Coast Guard Series HH-3F Helicopters (T.O. 1H-3(H)F-2) Series

-2 Ground Handling, Servicing, Lubrication and Airframe Group, 15 May 1983

-3 Utility Systems, 1 Feb. 1983.

-4 Power Plant and Transmission systems, 15 April 1983.

-5 Rotor and Flight Control Systems, 15 April 1983.

-6 Instruments, 1 May 1983

-7 Electrical Systems, 1 May 1983

-8 Communications and Navigation Systems, 1 April 1983.

NOTICE TO STUDENT

The primary purpose of this pamphlet is to present the duties of an aircrewmember before, during, and after the flight. The emphasis is placed on the correct procedures and voice reports for the rescue hoist, the rescue recovery platform and cargo sling. Also covered are the crew duties, emergency duties, extreme environmental condition procedures, and the high-intensity searchlight. This pamphlet will give you the information needed to help you complete your flight syllabus and to qualify as a flight mechanic or avionicsman on the HH-3F.

IMPORTANT NOTE: This text has been compiled for TRAINING ONLY. It should NOT be used in place of official directives or publications. The text information is current according to the references listed. You should, however, remember that it is your responsibility to keep up with the latest professional information available.

Each assignment is divided into three parts:

Reading assignment and objectives.
Reading material.
Self-quiz with answers and page references. The answers are located on the even numbered page immediately following the quiz.

This pamphlet is included in a course that is only one part of the total Coast Guard Aircrew training program. By its very nature, the course can take you only part of the way to a training goal. Practical experience, schools, selected reading, HH-3F audio visual programs, and the desire to excel are also necessary to round out a successful training program.

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FLIGHT PREPARATION

Reading Assignment: 1
Pages 1-1 through 1-5

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. State the normal minimum flight crew.
2. List the flight mechanic's and avionicsman's duties.
3. Describe the passenger briefings.
4. Explain the preflight inspections.
5. List items of a SAR equipment inspection.
6. State the use of the safety restraints.
7. Describe the inflight safety check.

CREW DUTIES

The normal crew of the HH-3F helicopter will consist of a pilot, copilot, flight mechanic, and avionicsman. The minimum crew will consist of a pilot, copilot, and flight mechanic. A safe and efficient operation of the helicopter requires precise crew coordination and discipline. All members of the crew must know their duties. This assignment covers the duties of the flight mechanic and avionicsman.

FLIGHT MECHANIC

The duties of the flight mechanic normally include, but are not limited to:

1. Perform routine mechanic duties such as servicing and maintenance when away from home base.
2. Supervise all activities in the cabin.
3. Operate the rescue hoist and platform.
4. Supervise cargo loading and offloading.
5. Operate the manual fuel dump valves and actuate the auxiliary flotation equipment.
6. Search.
7. Perform the duties of the avionicsman, as required, when one is not assigned.
8. Remove landing gear pins prior to pilot's preflight inspection.
9. Conduct an in-flight safety check after takeoff and every 30 minutes. Before conducting the safety check, the flight mechanic shall either close the door or, with the seat in the forward locked position, swivel the seat inboard before releasing the shoulder harness. This check includes, but is not limited to:

   a. Engine and transmission gages for normal indications.
   b. Cockpit overhead circuit breaker panels for popped circuit breakers.
   c. AFCS control compartment for leaks and security of the servo unit, control rods, and the mixing unit.
   d. Helicopter exterior for leaks, loose cowling, and security of long wire antennas.

e. Deck fittings and outboard deck channels for evidence of leaks.

f. Engine and transmission deck drain lines for leaks.

g. Airframe fuel filter inlets and outlets for leaks.

h. Radio rack for overheating.

i. Heater fuel control for leaks.

j. General cabin area for leaks and security of equipment.

k. Advise pilot to cross-check compass and check fuel quantity.

10. Conduct the hoist check prior to each flight.

a. Check hoist for security and leaks.

b. Extend the cable for approximately 3 feet.

c. Inspect the cable for broken strands, birdcaging, or other damage. The hoist may not be used if any of the cable strands are broken.

d. Inspect the hook for damage, pin installed and safetied, and roll pin properly installed.

e. Operate manual speed control up and down. Speed should be 100'/min. for 5 to 7 feet while extending, then speed up to 200'/min. When coming up, the speed should slow to 100'/min. at 5 to 7 feet from the end of the cable. Do not allow the hook to strike the ground.

f. Operate the electrical hoist control switch and check for proper operation at 100'/min travel. Depress the up limit switch and the hoist must stop.

g. Return the cable to full up.

h. Check hot mike operation.

i. Report hoist check complete and request hoist power be secured.

AVIONICSMAN

The duties and responsibilities of the avionicsman include, by are not limited to:

1. Operate all communication and navigation equipment at the radio position.
2. Maintain in-flight logs, records, and navigation plots as required.
3. Search.
4. Maintain hover position, when directed, through the use of the hover trim stick.
5. Assist the flight mechanic as required.

BRIEFING GUIDES

The following briefing guides help the pilot conduct briefings applicable to the type of mission assigned. The aircrewmember should be familiar with these briefing guides.

Crew

1. Mission requirement
2. Flight plan
3. Fuel load
4. Emergency-survival equipment
5. Weather
6. Crew duties and responsibilities

Passenger

The aircrewmembers must ensure that all passengers embarked receive an adequate briefing. This briefing must encompass at least:

1. Use of life jackets (if flight overwater).
2. Action required in case of ditching or crash landing.
3. Emergency exits.
4. Use of other emergency equipment.
5. No smoking and seat belt rules and signals..
6. Movement within the helicopter.

INSPECTIONS

PREFLIGHT

The flight mechanic or maintenance personnel will normally preform a preflight inspection following the appropriate Computerized Aircraft Maintenance Program (CAMP) requirements. The pilot's preflight, walk-around inspection is done under the assumption that a normal preflight has already been completed and is the last inspection before flight. The flight mechanic and avionicsman should accompany the pilot on the walk-around inspection. The purpose of this inspection is to visually check the aircraft before flight, to ensure removal of any protective covers/devices, and to detect any damage or discrepancies which may have

developed since completion of the maintenance preflight inspection. The inspection will include, but is not limited to:

NOTE

When operating away from home and in areas where maintenance personnel are not able to perform inspections, the flight mechanic will ensure the accomplishment of the preflight inspection in accordance with CAMP requirements.

Exterior (Figure 1-1)

1. Aircraft general--a walk-around inspection, checking for visable fuel and oil leaks, security of inspection panels and doors, and the presence of foreign matter such as ice, snow, and frost.

2. Main and tail rotor blades.

3. Main landing gear pins removed and chocks in place.

4. Protective covers and tiedown equipment removed.

WARNING

The transmission work platform and latch handle can be placed in the stowed position without a positive locking action, allowing the transmission platform to open in flight. A visual inspection should be made to ensure the work platform is completely closed.

Interior

1. Landing gear control handle down.

2. Cargo, seats, miscellaneous equipment secured.

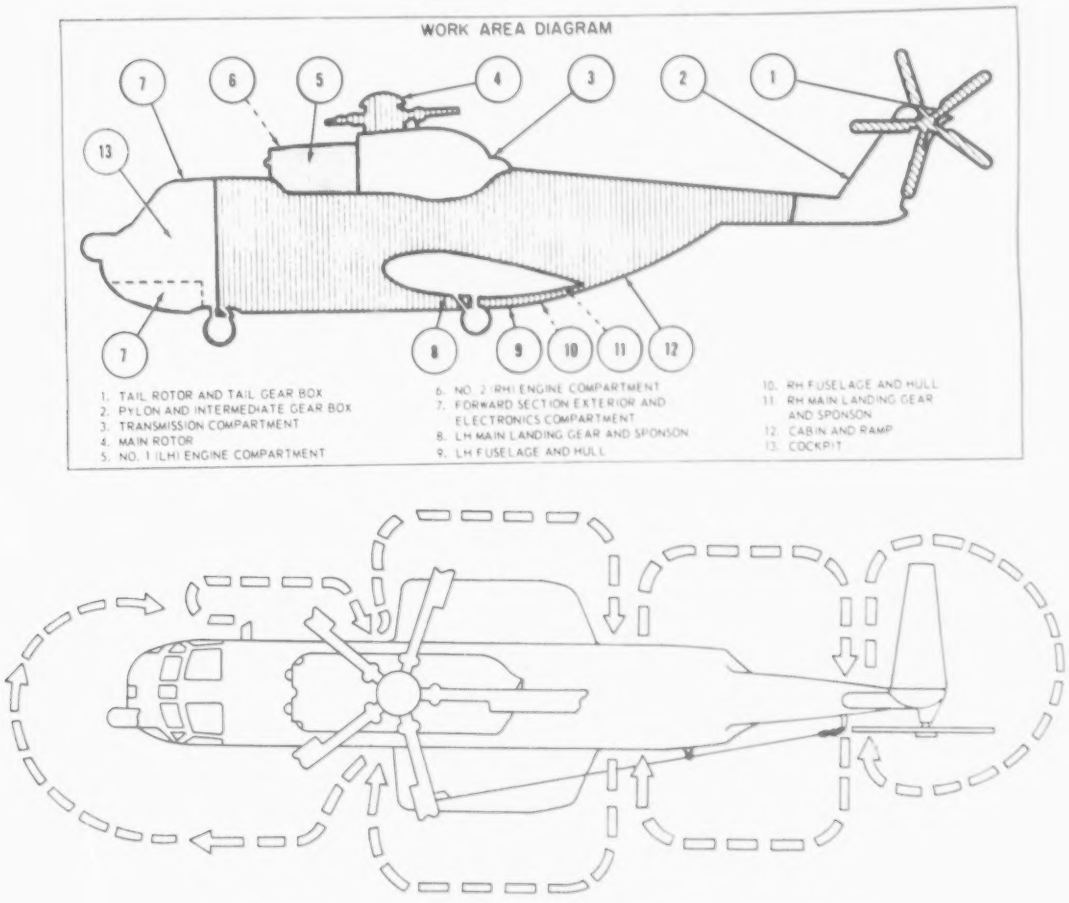

WORK AREA DIAGRAM
1. TAIL ROTOR AND TAIL GEAR BOX
2. PYLON AND INTERMEDIATE GEAR BOX
3. TRANSMISSION COMPARTMENT
4. MAIN ROTOR
5. NO. 1 (LH) ENGINE COMPARTMENT
6. NO. 2 (RH) ENGINE COMPARTMENT
7. FORWARD SECTION EXTERIOR AND ELECTRONICS COMPARTMENT
8. LH MAIN LANDING GEAR AND SPONSON
9. LH FUSELAGE AND HULL
10. RH FUSELAGE AND HULL
11. RH MAIN LANDING GEAR AND SPONSON
12. CABIN AND RAMP
13. COCKPIT

Figure 1-1. - Exterior Inspection and Walk-Around.

3. Ramp cables attached before takeoff.

4. All visible control cables.

5. Cockpit/cabin exits for obstructions.

Aircrew Preflight

As an aircrewmember, you are required to also make some last-minute checks or inspections. The inspection should include, but is not limited to:

1. Aircrewmember's safety harness for condition and personalized adjustment.

2. Cargo door strap for general condition.

3. Seat belts and seats for general condition and security.

4. Emergency exits for unobstructed passage and release handles for proper positioning and break away type safety wiring.

5. SAR mission equipment for minimum quantities and general condition. Here are the recommended minimum quantities of SAR equipment to be carried aboard the helicopter.

a. 1 ea. - message board
b. 1 ea. - rescue basket
c. 1 ea. - rescue sling
d. 1 ea. - rescue platform
e. 1 ea. - Stokes litter
f. 4 ea. - life preservers LPP-1 (Passenger)
g. 6 ea. - Survival radio AN/PRC-90
h. 1 ea. - LRU-13A life raft
i. 1 ea. - datum marker buoys
j. 6 ea. - first aid kits
k. 1 ea. - crash or survival axe
l. 6 ea. - Survival vests

The following items will normally be on the SAR board or in the SAR box. The location depends upon station preference (Figure 1-2).

a. 1 ea. - boat hook
b. 1 ea. - cable cutter
c. 1 ea. - cable splicer

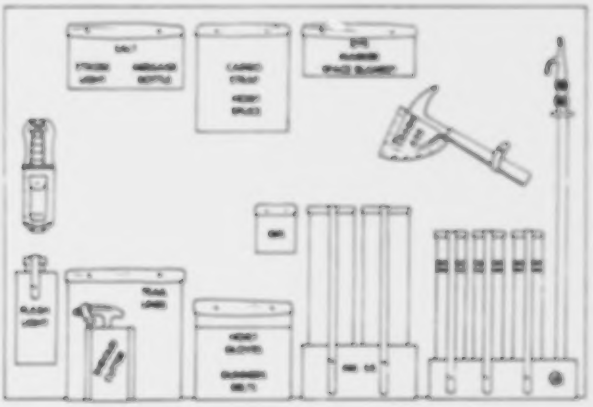


Figure 1-2. - Typical SAR Board.

d. 3 ea. - cargo tiedowns
e. 2 ea. - dye marker
f. 1 ea. - flashlight
g. 2 ea. - strobe lights with/float
h. 2 pr. - gloves, working
i. 1 ea. - knife
j. 6 ea. - message containers
k. 3 ea. - MK-25 marine location marker
l. 2 ea. - MK-58 marine location marker
m. 15 ea. - salt packets
n. 1 ea. - shroud cutter
o. 4 ea. - space blankets
p. 2 ea. - wool blankets
q. 1 ea. - 105-foot trail line
r. 1 ea. - 210-foot trail line
s. 2 ea. - weights, trail line, 5 pounds ea.

SAFETY

SAFETY BELTS

During routine landings and takeoffs and when directed, the flight mechanic and avionicsman will be seated with seat belts and harnesses fastened and seats facing forward. During flight, each crewmember and passenger must be seated with belts fastened except when necessary to move about or when the pilot has granted permission.

CREWMEMBER'S SAFETY HARNESS

The safety harness is to be worn by all persons not strapped in a seat while the cabin

door or ramp is open during flight. The harness's primary use is during hoisting operations and/or activities near the open cargo door. The harness may be attached to any tiedown fitting on the cargo floor or overhead fitting behind the avionicsman's seat. The aircrewmember may attach the safety harness to a jumpseat seat belt ring or troopseat seat belt ring (below hoist control handle) to enable movement to the outboard edge of the rescue platform.

CARGO DOOR SAFETY STRAP (Figure 1-3)

The helicopter is equipped with a safety strap installed on the cargo door for restraining personnel. The strap is to be across the opening of the cargo door whenever the aircraft is in motion except when operational necessity dictates otherwise, such as during a hoist or platform operations. The safety strap is a fixed-length, nonadjustable strap. The forward end is permanently attached to an eyebolt and ring assembly on the cargo door's forward frame (station 137). The right end of the safety strap has a quick-release snap that attaches to a ring and eyebolt assembly on the cargo door rear frame. During loading, or whenever the safety strap is not required, it is stowed by attaching the right end snap to the ring on the forward door frame.

REPORTS

During the flight, there are several required reports. Most of them are self-explanatory. One report needs to be explained because of its meaning. This report is "Crew ready for takeoff" or "Crew ready for landing," which means:

1. Flight mechanic and avionicsman shoulder harnesses fastened.

2. All occupied movable seats facing forward.

3. All cargo and rescue equipment stowed and secured.

4. All passengers seated with seat belts fastened.

5 Safety strap across the cabin door.

6. Smoking lamp out.

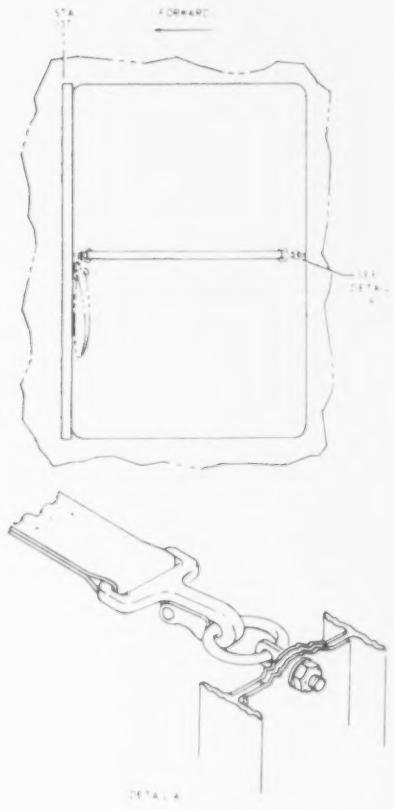


Figure 1-3. - Cargo Door Safety Strap.

SELF QUIZ #1

1. How many persons are required for the flight crew under normal conditions?

   A. Two
   B. Three
   C. Four
   D. Five

2. How many items must be covered in the basic passenger briefing?

   A. 4
   B. 6
   C. 8
   D. 10

3. Which item is NOT normally checked during an in-flight safety inspection?

   A. AFCS control compartment
   B. Long wire antenna
   C. Engine and transmission gages
   D. Seat belts and safety harness

4. For a hoist operation, the safety harness is normally connected to _____.

   A. any tiedown fitting on the floor only
   B. the overhead fitting behind the radio seat only
   C. the jumpseat seat belt ring only
   D. any tiedown or the overhead fitting

5. What is the MINIMUM recommended number of crewmember safety harness (es) carried in the helo?

   A. One
   B. Two
   C. Three
   D. Four

6. The MINIMUM flight crew consists of _____.

   A. pilot and copliot
   B. pilot, copilot, and flight mechanic
   C. pilot, flight mechanic, and avionicsman
   D. pilot, copilot, flight mechanic, and avionicsman

7. Which of the following is NOT required for a passenger briefing?

   A. Emergency exits
   B. No smoking and seat belt rules
   C. Use of emergency equipment
   D. Emergency ICS procedures

8. Which aircraft inspection is the LAST one performed before flight?

   A. Pilot's walk-around
   B. Flight mechanic's walk-around
   C. Maintenance preflight
   D. Thru-flight

9. Which item is NOT normally found on the SAR board?

   A. Boat hook
   B. Cable cutter
   C. Flashlight
   D. First aid kit

10. Which of the following is part of the pilot's preflight?

    A. Ramp cables
    B. Safety harness
    C. Cargo door strap
    D. SAR equipment

SELF QUIZ #1 (CONT.)

Question 11 through 20 include a list of aircrew duties. Match each duty to the correct aircrewmember (s) by answering:

A. Flight mechanic only
B. Avionicsman only
C. Flight mechanic and avionicsman
D. Neither one

11. Operate rescue hoist.

Answer _____

12. Remove landing gear pins during preflight.

Answer _____

13. Search.

Answer _____

14. Maintain in-flight logs and records.

Answer _____

15. Maintain hover with the hover trim.

Answer _____

16. Conduct a safety check every 30 minutes.

Answer _____

17. Supervise cargo loading and unloading.

Answer _____

18. Operate the manual fuel dump valve.

Answer _____

19. Actuate the auxiliary flotation equipment.

Answer _____

20. Operate all radio equipment at the radio position.

Answer _____

21. Which of the following is NOT part of the passenger briefing?

A. Smoking rules
B. Use of life jacket
C. Emergency alert signals
D. Ramp operation for bailout

22. Which item is NOT checked during the aircrew SAR equipment preflight?

A. Rescue platform
B. Datum marker buoy
C. Hoist hook
D. Crash axe

23. How many dye markers are recommended to be carried on the SAR board?

A. One
B. Two
C. Three
D. Five

24. Which of the following is NOT part of the aircrew preflight inspection?

A. Emergency exits
B. Seats
C. Life raft
D. Control cables

25. Which of the following is part of the passenger briefing?

A. Hoist operation
B. ICS procedures
C. Use of the safety harness
D. Movement within the helicopter

26. What is meant by "Crew ready for take-off"?

A. Flight mechanic and avionicsman facing forward only
B. All equipment is stowed only
C. All personnel aft strapped in with movable seats forward, equipment stowed, and smoking lamp out
D. Smoking lamp out and strap across the door only

27. What is the purpose of the walk-around inspection?

A. Ensure all protective covers have been removed only
B. Detect any damage or discrepancies that may have developed only
C. Visually inspect A/C for protective covers/devices, discrepancies, and damage before flight
D. Inspect for fluid leaks only

28. What is the recommended number of first aid kits carried in the helicopter?

A. Two
B. Three
C. Five
D. Six

29. The in-flight safety check must be completed after takeoff and every ___ minutes for the duration of the flight.

A. 15
B. 30
C. 45
D. 60

30. What is the use of the nonadjustable safety strap?

A. Safety belt
B. Cabin door opening restraining strap
C. Basket restraining strap
D. Safety harness

31. How many blankets, space and wool, are recommended to be carried on board the helo?

A. Two
B. Four
C. Six
D. Eight

32. What is the MINIMUM recommended number of life preservers to be carried in the helicopter?

A. Two
B. Four
C. Five
D. Six

33. Which of the following is NOT checked during the in-flight safety inspection?

A. Overhead circuit breakers
B. RF filters
C. Airframe fuel filter
D. Cross-check of compass and fuel quantity

34. The crewmember's safety harness is to be worn by all persons who are _____.

A. not strapped in while the cabin door or ramp is open
B. not seated while the cabin door is open only
C. involved in a hoist only
D. seated aft of the flight mechanic only

35. What is the MINIMUM recommended number of strobe lights with/floats on the SAR board?

A. Two
B. Three
C. Four
D. Five

ANSWERS TO SELF-QUIZ #1

QUESTION	ANSWER	REFERENCE
1	C	1-1
2	B	1-2
3	D	1-1
4	D	1-4
5	B	1-4
6	B	1-1
7	D	1-2
8	A	1-2
9	D	1-4
10	A	1-4
11	C	1-1 & 1-2
12	A	1-1
13	C	1-1 &1-2
14	B	1-2
15	B	1-2
16	A	1-1
17	A	1-1
18	A	1-1
19	A	1-1
20	B	1-2
21	D	1-2
22	C	1-4
23	B	1-4
24	D	1-4
25	D	1-2
26	C	1-5
27	C	1-2
28	D	1-4
29	B	1-1
30	B	1-4 & 1-5
31	C	1-4
32	B	1-4
33	B	1-1 & 1-2
34	A	1-4
35	A	1-4

EMERGENCIES AND EXTREME ENVIRONMENTAL CONDITION OPERATIONS

Reading Assignment: 2
Pages 2-1 through 2-11

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. Explain the procedures used during in-flight emergencies for fire, auto, ditch, and bailout.
2. State the location of and the deployment procedures for the auxiliary flotation system.
3. Describe the procedures for deploying of the anchor and sea anchor and for the towing operation.
4. Describe the emergency egress procedures.
5. State the location and operation of the emergency exits.
6. State the location and quantity of each piece of emergency equipment.
7. Explain the ground handling procedures for cold weather operations.
8. Explain the ground handling procedures for hot weather operations.

IN-FLIGHT EMERGENCIES

As a SAR aircrewmember you will be required to perform emergency duties if necessary. These are in addition to your regular duties. The following information will acquaint you with these emergency duties and situations.

AUTOROTATION

When an autorotation is evident during flight, you must make sure that all loose gear is stowed or secured. The cargo door should be opened if time permits. Make sure that all passengers are advised and are secured in their seats. Finally, you must be seated and strapped in. Report "All secure" to the pilot. The avionicsman will transmit a distress message. After the landing, perform emergency egress procedures.

COCKPIT/CABIN FIRE

If a cabin or cockpit fire occurs in-flight, close all windows, the door, and the ramp. The next step is to ensure that the heater and vent switches are off. Now, man the fire extinguisher, proceed to the scene of the fire, and fight the fire. Keep the pilot advised of the status of the fire and damage. If the fire is electrical, pull the appropriate circuit breakers. Stand by for an emergency landing. If the fire becomes uncontrollable, you may have to bail out.

The severity of the fire and actual flight conditions (night or instrument) will dictate the immediate procedure to be followed. It may be more advisable to let the fire burn, if it is isolated, than to secure all electrical power and lose AFCS and flight instruments before achieving VFR conditions.

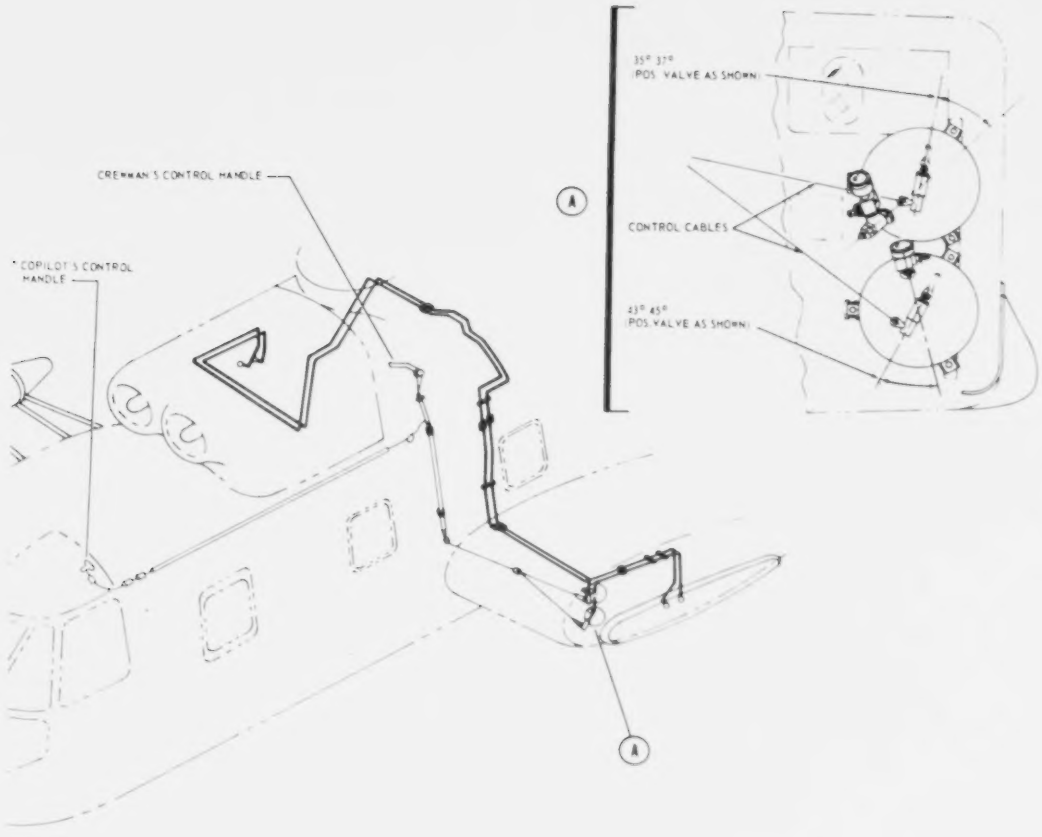


Figure 2-1. - Auxiliary Flotations System.

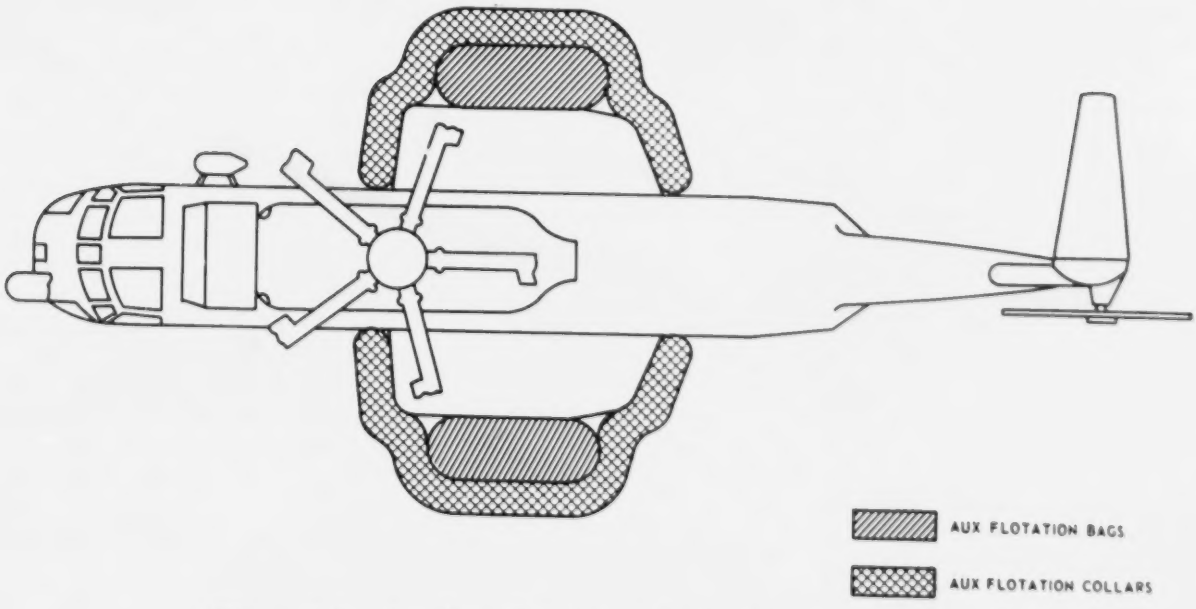


Figure 2-2. - Auxiliary Foltation Bag and Collar Placement.

SMOKE AND FUME ELIMINATION

The pilot's compartment windows and the cargo door have proven, through flight tests, to be the most effective way to eliminate smoke and fumes from the aircraft. To prevent the fumes and smoke from venting through the cockpit, do not open the cockpit windows if the cargo door is closed. The cabin door must be opened first. If fuel fumes are present, communications should be limited, if possible, to the transmission of intentions. To avoid possible damage to the rotor blades, do not jettison any windows or the door while the helicopter is in forward flight.

Normally there are no toxic quantities of carbon monoxide gas or other gases present from the engine exhaust. Objectionable odors of the engine exhaust gases are sometimes encountered in the helicopter during ground run-up, taxiing, or single-engine flight with one engine in ground idle. These odors may be avoided by heading the helicopter into the wind and/or closing the pilot's compartment window and the cargo door. Opening the cargo door and the pilot's compartment windows in-flight will assist in removing objectionable fumes and odors.

BAILOUT

Bailout is recommended if, and only if, it is impossible to make a safe emergency landing. Bailout is possible either at level flight or during an autorotation. The minimum bailout altitude is 1,000 feet above gound level (AGL). The crew will normally use the cargo door, but, at the pilot's discretion, the ramp may be opened in flight and used as an exit. The ramp should be limited to one person at a time. The crewmembers should dive out and down from the exit with the arms close to the body and the head down. Wait until clear of the helicopter before pulling the rip cord to avoid fouling the parachute.

The bailout procedures are as follows:

1. Airspeed -- 70 knots
2. Attitude -- level flight
3. Wheels -- up
4. Cargo door -- open (if the cargo door will not open, pull the emergency handle and jettison the door).
5. Cargo compartment occupants and copilot -- bailout cargo door.
6. Pilot -- jettison sliding window and exit by diving out and down. Depending upon the circumstances, the pilot may elect to use the cargo door.

EMERGENCY LANDINGS

WATER OR DITCHING

When an emergency water landing is evident, the cargo door and cockpit windows should be opened. If time permits, remove and stow the sponson emergency exit windows. Strap youself in and follow the emergency egress procedures. After the aircraft is on the water, the wheels should be lowered to lower the helicopter's center of gravity. When directed by the pilot, activate the auxiliary flotation system. It may be necessary to launch the sea drogue or anchor or to install the flotation collar. If it is necessary to abandon the helicopter, the flight mechanic will direct the evacuation of the cabin and provide the raft and any other gear that might be needed. One rule of thumb is to take everything you can carry.

Auxiliary Flotation System (Figure 2-1)

The auxiliary flotation system gives the helicopter additional stability while on the water with the rotor system stopped. The auxiliary flotation system consists of two inflatable bags, two compressed air cylinders, and a manual release. A bag is located on the outboard chine of each sponson and is stowed in a fabric enclosure. The bags are inflated by two cylinders located in the leading edge of the left sponson. Each bag is divided into two compartments, fore and aft. The forward compartment of each bag is inflated by the bottom air cylinder, and the aft compartment is inflated by the top cylinder. The two air cylinders are connected to their respective bag compartments by separate air lines. This system of inflation ensures a symmetric configuration of the pop-out bags in the event of damage to any

component. The system is activated by pulling the AUX FLOAT handle down. The handle is located on the left side of the cabin between and above the second and third windows. An additional release handle is mounted aft and above the copilot's seat. Pressure gages are provided for both air pressure cylinders and can be viewed through a window in the left sponson. The cylinders are fully serviced if the gages indicate between 2,400 and 2,800 psi.

Auxiliary Flotation Collar (Figure 2-2)

The auxiliary flotation collar system provides increased lateral stability while the helicopter is on the water with the rotor system stopped. The auxiliary flotation collar system consists of two collars: one for attachment to the left sponson (container identified by LEFT HAND and has a RED STRIPE) and one for attachment to the right sponson (container identified by RIGHT HAND and has a GREEN STRIPE). Each collar is packed in a modified MARK-7 life raft container, and each weighs approximately 60 pounds.

The collar system can be installed from the sponsons once the helicopter is on the water. Detailed installation instructions are located in the salvage portion of the HH-3F Maintenance Manual (T.O. 1H-3(H)F2-2). When both collars have been attached, they should be inflated simultaneously. The collars are made of raft fabric and contain primary and secondary inflation chambers. The inflation chambers are not interconnected and are inflated by separate self-contained CO_2 bottles.

CAUTION

Inflation of both chambers at the same time will cause overinflation and possible rupture of the collar. Do not inflate the secondary unless the primary compartment is completely deflated. If primary compartment deflation is imminent, carefully rupture outside skin and then inflate the secondary compartment. When collars are fully attached on both sides, pull yellow inflation lanyards to inflate both sides simultaneously. After inflation, recheck both sides and bring the secondary lanyard (green) to the exit for stanby emergency use.

A helicopter may take off from the water with the auxiliary flotation collars attached, but airspeed must be limited to 70 knots. Tow speeds of up to 4 knots may be used with the auxiliary flotation collars attached, depending on sea conditions.

Bow Line (Figure 2-5)

The bow line or attaching line is used as an attachment point for the anchor line, the sea drogue (sea anchor), or a tow line. The line is a 9/16-inch-diameter polypropylene line. One end of the line is connected to the nose ring. When not in use, the line runs underneath the pilot's window to a point just forward of the cabin door and is held taut by a bungee cord clipped to the fuselage. Also connected to the bow line is the retrieving line. This line is connected to a ring in the thimble and, when not in use, is coiled and laced with light cotton thread for storage.

Anchor (Figure 2-3)

The anchor system consists of an anchor and 150 feet of 5/16-inch-diameter nylon anchor line. The anchor line is chained and shackle-pinned to the anchor. A snap hook, fastened to the other end of the anchor line, is attached to the eye (thimble) of the attaching line (bow line). The anchor is then deployed from the cargo door. The anchor line should be at least three to four times the depth of the water in normal conditions. In rough or windy conditions, the line length should be six or seven times the depth. This provides for an essentially horizontal pull from which the line develops its holding power. Under extreme conditions, a ten to twenty pound weight may be attached to the anchor line. After the anchor has been lowered to the bottom, the entire length of anchor line must be payed out. Using the bow line provides a low center line attachment. This ensures that the helicopter will align with the wind and waves to present minimum drag and resultant minimum anchor line strain. In no case should the anchor line be shortened or the prescribed configuration altered by attaching the anchor line to any of the internal tiedown rings in the cabin.

The increased drag caused by the asymmetrical attachment and the resultant position broadside to the wind and waves can cause the anchor to drag or possibly capsize the helicopter.

Sea Anchor (Figure 2-3)

In emergency situations, if the depth of the water will not permit anchoring, the sea anchor (sea drogue) should be deployed to reduce drift and to align the helicopter into the wind, increasing lateral stability. The sea anchor is stowed on the forward left side of the cabin behind the radio seat. The unit consists of a parachute, nylon rope, rip cord, and a spring-loaded snap hook. The unit is deployed from the cargo door. The red hook at the end of the rip cord is pulled from the center of the pack and attached to the aircraft structure. (A convenient attachment point is the forward end of the cargo door safety strap ring.) The snap hook on the end of the sea anchor line is then attached to the eye of the bow line. After throwing the sea anchor overboard and forward, the rip cord is pulled to release the chute.

Towing, Water Emergency

The recommended attachment point for a tow line is the bow eye on the nose fitting. One recommended procedure is to have the boat retrieve the anchor line and use it if the line is deployed. The tow line should be approximately 100 feet to prevent the helicopter from surging up on the boat. When the tow boat comes along side to pass the line, use extreme care to prevent damage to the helicopter because the boat handling crew will probably not be experienced in towing operations. The boat should remain to the windward side of the helicopter because the helo will drift faster than the boat. Once the towing operation has started, the towing speed used will depend upon the sea conditions, but must not exceed 4 knots. The helicopter should be towed into the wind. But, avoid heading parallel to the wave troughs and 90 degrees to the wind since this may cause excessive roll and capsize the helo.

To help stabilize the helicopter, a trippable sea drogue may be streamed out the aft ramp, using one of the cargo tiedown

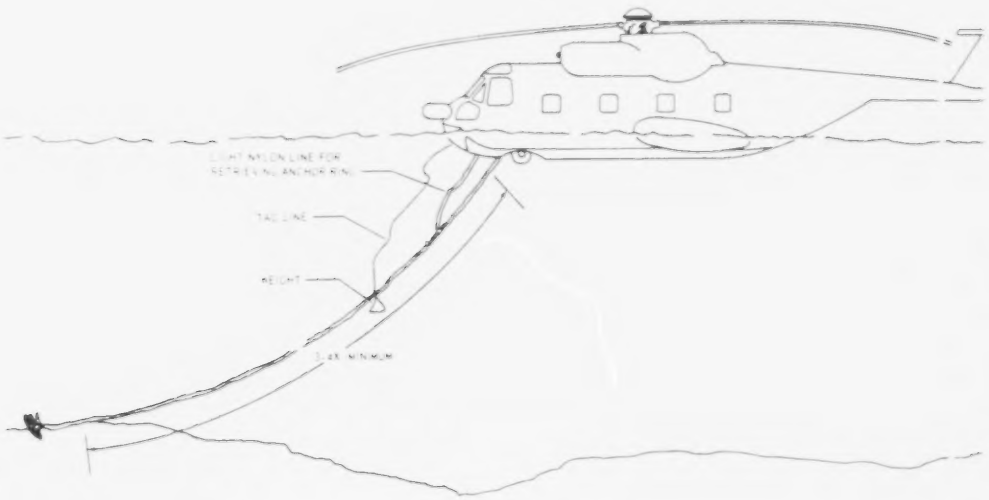


Figure 2-3. - Anchoring the Helicopter.

rings as the attachment point. Also, a recommended procedure is to lower the center of gravity to improve the stability, by lowering the landing gear and filling the fuel tanks. Of course, whenever the helo is dead in the water, the auxiliary flotation bags should be inflated and the auxiliary flotation collar installed.

GROUND

A successful landing with the landing gear retracted, or improperly lowered, is not as difficult to make with a helicopter as with a fixedwing aircraft. Proper selection of a landing site, and care during hovering or touchdown, will permit a landing with a minimum of danger to personnel and damage to the helicopter. If attempts to lower the landing gear by the alternate system are unsuccessful, it may be possible to jar the landing gear loose by an abrupt increase in collective pitch after a shallow dive. However, since the helicopter has water landing capabilities, a water landing may be made if facilities are available. Landings with all wheels retracted, or with any one or any two wheels down, may be made by placing soft objects, such as mattresses, under the malfunctioning landing gear (or gears) and the bottom of the fuselage. Ground personnel should place the soft objects before touchdown and then direct the pilot from a hover to a vertical landing on the objects.

After the aircraft motion has ceased and the rotors have stopped turning, the flight mechanic will direct the evacuation of the cabin. Disconnect the battery if time permits.

EMERGENCY EGRESS PROCEDURES

Because of the high probability of spatial disorientation due to aircraft attitude, damage, and/or environmental factors (night, water), all crewmembers must become familiar with normal/emergency aircraft escape routes and the egress procedures. The importance of the use of reference points cannot be overstressed.

1. Locate reference point and remain calm.
2. Disconnect mike cord.
3. Locate emergency exit release handle. Pull and jettison emergency exit.
4. Relocate reference point and hold.

   Land-- Wait until all buffeting stops(recommended 5-8 seconds).

   Water-- Take normal breath and wait until completely immersed (recommended 5-8 seconds).
5. Release seat belt harness.
6. Egress holding reference point and exit at right angles to the aircraft.
7. Inflate life vest when clear of the helo.

WARNING

Failure to maintain a handhold on a reference point until clear of the aircraft could result in disorientation. Also, inflation of the life vest inside the aircraft may inhibit the egress.

NOTE

A wet suit will exhibit some positive buoyancy when immersed.

EMERGENCY EXITS
(Figure 2-5)

COCKPIT SLIDING WINDOWS

An emergency escape hatch is on each side of the cockpit. The hatch consists of a fixed rear window and a sliding forward window in a jettisonable frame. The forward sliding window may be opened or closed by depressing the hand latch in the forward bottom corner of the window frame. When the hand latch is released, the sliding window will lock in position. The entire window can be jettisoned to provide an emergency exit for the copilot or pilot. The manual emergency release handle, marked EMERGENCY RELEASE PULL, is located below the forward edge of each window. The window is jettisoned by pulling the release handle up and pushing the window out. Each cockpit emergency exit may also

be removed from the outside by a release lever located below the aft-lower corner. The release lever is normally flush with the side of the aircraft. By pressing in on one end of the handle causes it to extend outward. To remove the window, pull the handle down and pull the window out from the helicopter.

LEFT SEARCH WINDOW

The left search window is located on the forward left side of the cabin. This window is commonly known as the radio operator's (avionicsman's) window. The window is the emergency exit for the avionicsman or any other person using the seat beside the window. The window is released by an emergency release handle located below the window. To jettison the window, turn the handle in the direction indicated by the arrow (forward) and push the window out. The window may also be removed from the outside by a release handle similar to the release handle for the cockpit windows. The operation is identical to the outside release of the cockpit windows.

CARGO DOOR

The main cabin exit is the cargo or personnel door located forward on the right side of the cabin. Normal operation of the door is controlled by a spring-loaded lever type handle on the forward middle portion of the door. Pull the handle or lever in the direction of desired door movement. The door contains an emergency release handle on the inside-top center of the door. When the handle is pulled down, the door is released from the upper door tracks. To complete the door removal, push out on the door. The door can be removed from the outside by pulling down on the emergency release handle, located at the top-center of the door, and pulling out on the door.

CARGO COMPARTMENT WINDOWS

A jettisonable window is located over each sponson. Below each window is a handle marked EMER EXIT, TURN PUSH. To open each window, turn the handle and push the window out. On the outside, below each window, is a handle marked EXIT RELEASE PULL DOWN. To open, pull down on the handle and pull the window out.

The windows immediately forward and aft of the sponson windows do not provide emergency exits. The windows have been modified and are permanently installed.

RAMP

Emergency exit can be made through the aft ramp by pulling the handle marked EMERGENCY EXIT RELEASE HANDLE on the starboard aft wall of the cargo compartment. The ramp can be lowered from the outside by pulling a handle, located below the tail pylon under a cover. RAMP RELEASE HANDLE PULL is marked beside the cover. When the handle is pulled and held in the down position, the ramp hydraulic cylinder moves to the open position and the aft ramp uplocks unlock. When the handle is held in the down position, the ramp will open by its own weight, permitting entrance to the cargo compartment.

EMERGENCY EXIT LIGHTS

The two removeable emergency exit lights are installed above the two cabin emergency exits. Each light has a self-contained battery that will cause the light to illuminate whenever DC power to the light is interrupted or when the main transmission oil pressure decreases to less than approximately 4 psi. The lights may be removed from the helicopter in the event of an emergency evacuation. To remove the light, pull the handle located at the top of each light. Once the light is removed, it may be turned off by pushing the handle in and turned on again by pulling the handle out.

EMERGENCY EQUIPMENT
(Figure 2-5)

PORTABLE FIRE EXTINGUISHERS

One hand-operated (CO_2) fire extinguisher is located in the cockpit on the bulkhead behind the pilot's seat. A second (CO_2) fire extinguisher is located on the right side above the ramp. The extinguishers are held in place by a bracket with a tight fitting quick-release spring.

FIRST AID KITS (Figure 2-4)

One first aid kit is mounted in the

cockpit on the bulkhead behind the pilot's seat. Five additional kits are installed in the cabin, one on the left and four on the right side. Each kit is held in place by a metal frame and supporting clips.

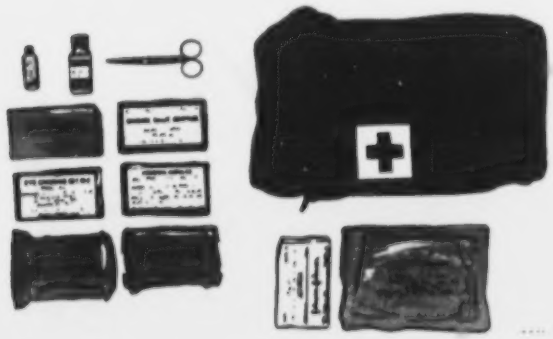


Figure 2-4. - First Aid Kit.

CRASH AXE

One crash axe is installed below the step at the cockpit entrance. The axe is secured by a bracket and strap.

SURVIVOR GRAB RAILS AND LIFELINES

Two metal grab rails are attached to the four universal sling fittings on the underside of the helicopter with two polypropylene lines crossing diagonally between them. The rails and lines provide a means of holding onto and securing items to the helicopter when it is capsized. The rails and line are removed when the external cargo sling is installed.

STOWAGE OF LIFE RAFTS AND LIFE JACKETS

The location of the LRU-13A life raft may vary from unit to unit. The acceptable location is behind the avionicsman's seat. Hangers are provided below the aft radio rack for storage of survival vests.

WATER CONTAINER

The 2-gallon drinking water container is located next to the relief tube on the left side of the forward ramp. The container is held in place by two quick-disconnect straps.

UNDERWATER ACOUSTIC LOCATOR BEACON (PINGER)

Each helicopter has a Dukane Model N15F210B "pinger" installed on the left side of the cabin at station 198. This battery-operated underwater acoustic beacon is a highly reliable, impactresistant, water-activated, lightweight unit. It will enhance locating crashed aircraft in a water environment of any depth to 20,000 feet and has an operating life of 30 days once activated.

ENVIRONMENTAL CONDITIONS

COLD WEATHER PROCEDURES

The major problems in cold weather operations are the preparation for flight, restricted visibility from blowing snow, and the adverse effects on helicopter materials. Moisture, usually from condensation or melted ice, may freeze in critical areas. Tire, landing gear strut, fire extinguisher bottle, and accumulator air pressures will decrease as the temperature decreases. Extreme diligence on the part of both ground and flight crews is required to ensure successful cold weather operations. Flight control hardovers have been induced by the freezing of condensation in the primary servos. If this condition exists and the APU is started, the flight controls may be in a hardover condition and remain there until the hydraulic system attains normal operating temperatures. Do not attempt to engage the rotor system if the above condition is suspected.

Aircrews should be aware that the horizon may be lost when flying over large unbroken expanses of snow. If such a situation exists, the helicopter should be flown entirely by instruments at safe instrument altitude. Colored glasses should be worn in snow areas to prevent snow blindness. The problems you encounter when operating from snow-covered surfaces are compounded when operating from other than an operational base. When the aircraft is hovering in loose or powdery conditions, all ground references may be lost due to blowing snow. Smoke

markers will assist in providing references and determining wind.

When the helicopter lands on snow, the main and tail rotor ground clearances are reduced with the helicopter resting on the fuselage. Therefore, personnel entering or leaving the helicopter should be extremely cautious to avoid being struck by the blades.

The rotor wash or wind will have a supercooling effect, which may reduce the efficiency of exposed personnel. Consequently, the time that survivors and/or ground personnel are exposed to the rotor wash should be held to a minimum.

As an aircrewmember/hoist operator, make sure static electricity generated by the helicopter is dissipated before attempting a sling or hoist pickup; this applies particularly in colder dry climatic conditions when static electricity buildups are large. To dissipate this static charge, allow the sling or hoist to touch the ground, or use a conductor to make contact between the helicopter and the ground. Use care not to break contact because the static charge will immediately rebuild.

Preparation For Flight

In addition to making a normal exterior inspection, thoroughly inspect engine inlets, rotor head, main rotor blades, tail rotor, and flight controls to make sure they are free of all ice and snow. Failure to remove snow and ice accumulations while on the ground can result in serious aerodynamic and structural effects when flight is attempted. Do not attempt to chip or scrape snow and ice from any surface or controls. Portable ground heaters or de-icing fluid may be used to remove any accumulation that cannot be swept off. Ice chocks are also recommended when practical.

Check to see that fuel tank vents, a battery compartment vent tube, and pitot tubes (including static ports) are free of snow and ice; that landing gear struts and tires are properly inflated; and that a warm, well-charged battery has been installed, if practicable. Check the engines for ice and snow. If ice or snow is found, thaw out the engine with hot air before attempting to start.

Starting APU

The lower the temperature, the greater the amount of accumulator pressure required for a start. At -54°C. (-65°F.), a pressure of approximately 4,000 psi is required for starting. Also at low ambient temperatures, clutch engagement time will increase due to greater breakaway torque levels among the accessories. The APU should be shut down if acceleration hangs between 76% and 85% for more than 4 seconds (6 seconds if below -29°C).

Warm-Up

At temperatures below freezing, a longer warm-up period is required to bring the engine and transmission oil temperature up to the desired operating range. As soon as the APU is started and on the line, turn on the cabin heater and windshield anti-ice system, close the cargo door, and remove the rubber transmission access panel. When the ambient temperature is below -6.7°C. (20°F.), operate the APU until the main transmission oil temperature indicates -6.7°C. (20°F.) before the rotor is engaged. Also be careful not to exceed the transmission oil pressure limitations when engaging the rotor. If the rotor brake fails, do not start the engines until the warm-up period is complete to prevent damage to the main transmission.

Engine Starting

At extremely low temperatures, it is possible that the engine oil pressure will go to a maximum value during an engine start. Ensure that ground heater ducts have been removed; then perform a normal engine start. If there is no indication of oil pressure after 30 seconds of engine operation at ground idle, or if oil pressure drops to zero after a few minutes of ground operation, stop the engines and investigate.

Takeoff and Flight

Before takeoff, select an area devoid of loose or powdery snow to minimize the restriction to visibility from blowing snow, and make sure the wheels are not frozen to the snow or ice. A "no hover" takeoff and climb should be executed.

During flight, use the cabin heater, engne inlet anti-icing, and windshield anti-ice protective systems, as required. After take-off from water, wet snow, or slush-covered fields, operate the landing gear through several complete cycles to prevent the gear from freezing in the retracted position. (Expect slower operation of the landing gear in cold weather due to thickening of all lubricants.)

Landing

Landings are made in a normal manner, except the approach must be made with a minimum hover before touchdown. This approach minimizes the rotor wash on loose or powdery snow with reduced visibility. After contacting the surface, maintain maximum rpm while slowly lowering the collective until the wheels come to rest on a level plane or the fuselage rests on the surface. This will prevent any serious consequences if one wheel should hang up or break through a crust of snow. Except in emergency, never reduce the rpm until it is determined that the helo will not settle.

Securing

After making normal engine shutdown and parking the helicopter, chock the wheels and release the parking brake. At extremely low temperatures, the collective pitch lever friction lock is to be left in the OFF position. If left ON and the helicopter is cold soaked, the friction lock nut will contract on the collective pitch lever, causing the lock nut to bind. The cockpit will have to be heated sufficiently to allow the friction lock nut to expand and again be moveable.

Make ever effort during servicing to prevent moisture from entering the fuel system. When possible, leave the helicopter parked with full tanks. Drain condensation from the fuel and oil sumps and drains, and remove all ice from vents, drains, and breathers. Close the door, ramp, all windows, and maintenance platforms. Clean the oleo struts of dirt, snow, and ice with a clean cloth soaked in hydraulic fluid. If the helicopter is to remain outside for a period of more than 4 hours at below freezing temperatures, or less than 4 hours at temperatures below -25°C. (-13°F.), remove the battery and store in a heated room. Check to ensure that protective covers have been installed. If the helo is secured on a snow-packed or ice-covered surface, consider using ice chocks.

HOT WEATHER PROCEDURES

Hot weather operation, as distinguished from the desert operation, generally means operation in a hot, humid atmosphere. High humidity usually results in the condensation of moisture throughout the helicopter. Possible results include malfunctioning of electrical equipment, fogging of instruments, rusting of metal parts, and the growth of fungi in vital areas. Futher results may be pollution of lubricants and fluids and the deterioration of nonmetallic materials.

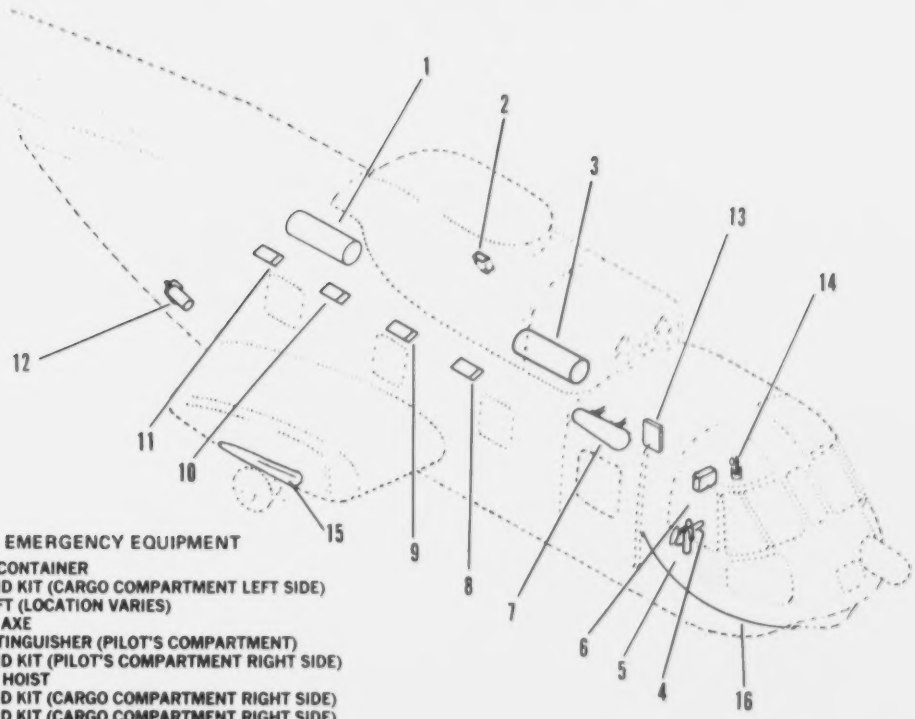
Normal procedures will be followed for all phases of operation, with the emphasis placed on the data provided here. More power will be required to hover during hot weather than on a standard day. Hovering ceilings will be lower for the same gross weight and power settings on a hot day. As fuel density decreases with a rise in ambient temperature, total useable fuel quantities will be reduced, thus resulting in a decrease in normal operating range. Check for the presence of corrosion or fungus at joints, hinge points, and similar locations. Any fungus or corrosion found must be removed. If instruments, equipment, and controls are moisture coated, wipe them dry with a clean, soft cloth.

After Landing

When the helicopter is parked, the doors and windows, except the cockpit windows, should be opened if weather permits. The cockpit windows should remain closed to prevent unexpected rain showers from pooling water on control panels. The water could create short circuits.

Desert Operations

Desert operation generally means operation in a very hot, dry, dusty, often-windy atmosphere. Under such conditions, sand and dust will often be found in vital areas of the helicopter. Sand and dust may cause severe damage to the affected parts.



EMERGENCY EQUIPMENT

1. WATER CONTAINER
2. FIRST AID KIT (CARGO COMPARTMENT LEFT SIDE)
3. LIFE RAFT (LOCATION VARIES)
4. ESCAPE AXE
5. FIRE EXTINGUISHER (PILOT'S COMPARTMENT)
6. FIRST AID KIT (PILOT'S COMPARTMENT RIGHT SIDE)
7. RESCUE HOIST
8. FIRST AID KIT (CARGO COMPARTMENT RIGHT SIDE)
9. FIRST AID KIT (CARGO COMPARTMENT RIGHT SIDE)
10. FIRST AID KIT (CARGO COMPARTMENT RIGHT SIDE)
11. FIRST AID KIT (CARGO COMPARTMENT RIGHT SIDE)
12. FIRE EXTINGUISHER (CARGO COMPARTMENT)
13. SEA ANCHOR
14. ANCHOR
15. AUXILIARY FLOTATION
16. BOW LINE

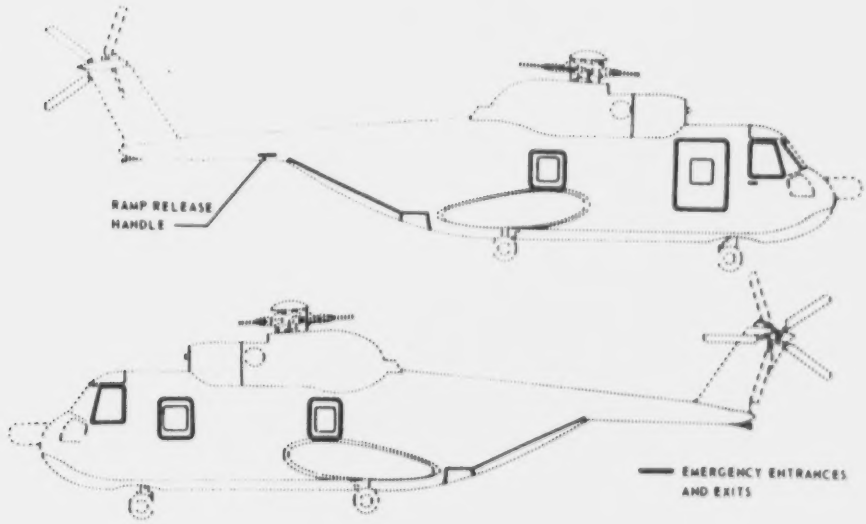


Figure 2-5. - Emergency Exits and Equipment Location.

The helicopter should be towed into takeoff position, which, if possible, should be on a hard, clear surface, free from sand and dust.

PERPARATION FOR FLIGHT: Check for the presence of sand and dust in control hinges and actuating linkages, and inspect the tires for proper inflation. High temperatures may cause overinflation. Check the oleo struts for sand and dust, especially in the area next to the cylinder seal, and remove any accumulation with a clean, dry cloth. Inspect for, and have removed, any sand or dust deposits on instrument panels and switches, and on and around flight and engine controls.

ENGINE STARTING, WARM-UP, AND GROUND TESTS: If possible, engine starting and ground operation should be done from a hard, clean surface. Complete the normal engine start, warm-up , and ground test, but limit ground operations to a minimum, because the downwash from the main rotor may stir up clouds of sand. Make every effort to minimize the amount of sand being blown up around the main rotor and engines.

FLIGHT: When it is absolutely necessary to taxi in sand and dust, get the helicopter airborne as quickly as possible to minimize sand and dust intake by the engines. Execute a "no hover takeoff." Avoid flying through sand and dust storms since excessive grit in the air will cause considerable damage to internal engine parts. The best type of landing is the running type because it minimizes the blowing sand and dust.

SECURING: Shut down the engine as soon as practical after landing to minimize the ingestion of sand and dust. Install all protective covers and shields. Leave windows and doors open to ventilate the helicopter except when sand and dust are blowing.

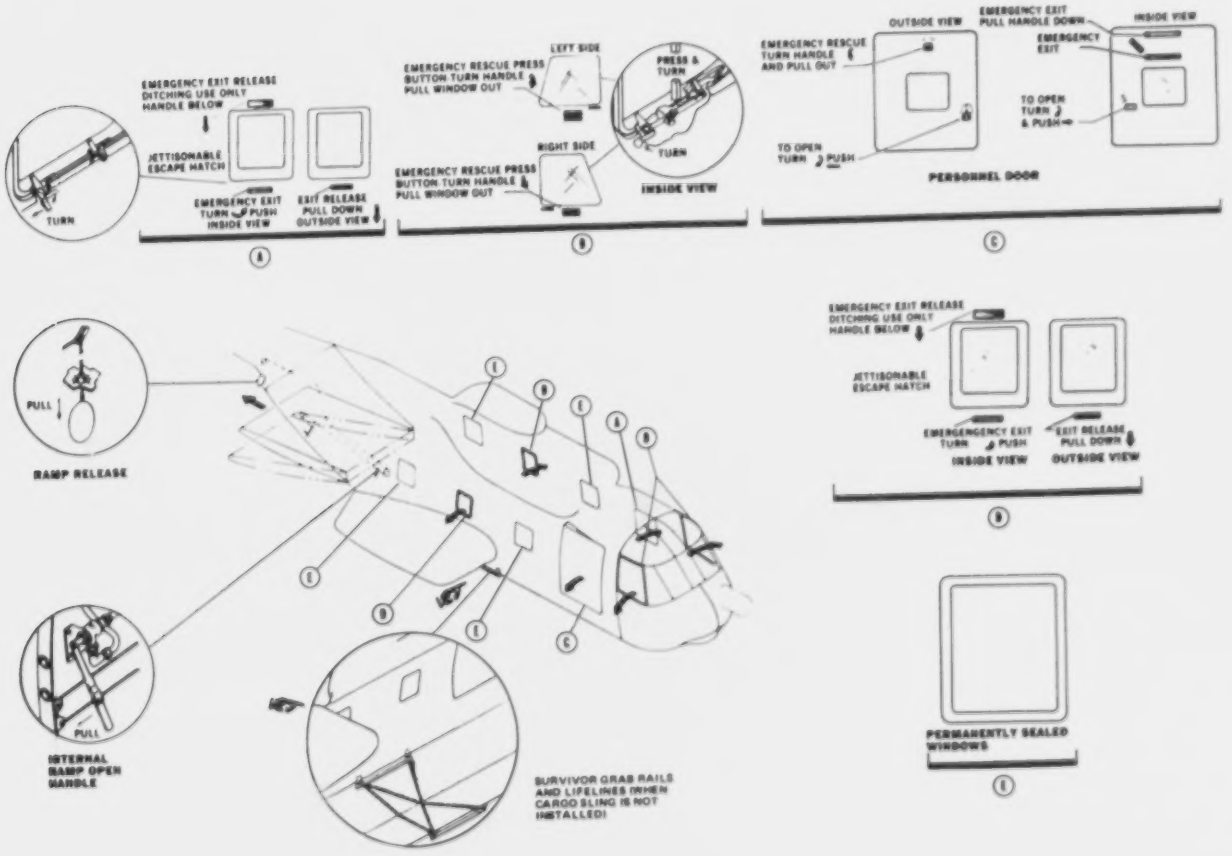


Figure 2-5. - Emergency Exits and Equipment Location.

SELF QUIZ #2

1. When an autorotation is evident, what should you do if time permits?

   A. Brief the passengers
   B. Open the cargo door
   C. Stow loose gear
   D. Strap yourself in

2. The PRIMARY crew exit for bailout is _____.

   A. the cargo door
   B. the ramp
   C. a cockpit compartment window
   D. any emergency exit window

3. Where are the aux flotation air cylinders located?

   A. Left sponson
   B. Right sponson
   C. One in each sponson
   D. Inside cabin left side

4. The free end of the bow line is stowed just forward of the _____.

   A. cabin door
   B. pilot's window
   C. copilot window
   D. left search window

5. The importance of using a reference point during emergency egress is to _____.

   A. help brace for impact
   B. eliminate disorientation
   C. provide a means of ejection
   D. give a feeling of security

6. The cabin has a total of _____ emergency exits.

   A. four
   B. five
   C. seven
   D. nine

7. The cargo compartment windows are jettisoned by _____.

   A. kicking them out
   B. pulling the tab and removing the weather stripping
   C. turning the release handle and pulling in
   D. turning the release handle and pushing out

8. What is/are the location(s) of the crash axe(s)?

   A. Behind the radio seat and the flight mechanic seat
   B. Below the step to the cockpit entrance and on the left side upper ramp
   C. Below the step to the cockpit entrance
   D. On the left side upper ramp

9. As fuel density decreases with a rise in ambient temperature, the normal operating range will _____.

   A. increase
   B. decrease
   C. fluctuate with the humidity
   D. remain the same

10. What is one step in combating a cabin fire?

    A. Turn heater and vent switches on
    B. Open cockpit windows
    C. Open cabin door
    D. Close door, ramp, and all windows

11. What is the proper way to bail out of the helo?

A. Jump out feet first with arms spread
B. Dive out and down with arms and legs spread
C. Jump out feet first with arms close to the body
D. Dive out and down with arms close to the body and head down

12. Which air cylinder inflates the forward compartment of the aux flotation bags?

A. Left
B. Right
C. Top
D. Bottom

13. Under normal conditions, the anchor line should be AT LEAST _____ times the depth of the water.

A. one to two
B. three to four
C. four to five
D. six to seven

14. For water emergency egress procedures, when is the life vest inflated?

A. Before the landing
B. After all the buffeting stops
C. When clear of the helicopter
D. When on the surface

15. The left search window's emergency release handle is located _____ the window.

A. above
B. forward of
C. below
D. aft of

16. The ramp's external release handle is located _____.

A. below the tail pylon
B. forward of the ramp on the right side
C. forward of the ramp on the left side
D. on the upper-right corner of the ramp

17. Where are the life jackets stowed?

A. Along the left side of the cabin
B. Under the aft radio rack
C. Above the aft radio rack
D. Between the radio rack and the flight mechanic's seat

18. Which item is NOT a problem of hot weather operations?

A. Fogging of instruments
B. Growth of fungi
C. Dryness
D. Malfunctioning of electrical equipment

19. It may be advisable to allow an in-flight fire to burn when _____.

A. the fire is just smoldering
B. IFR and power to the flight instruments would be lost
C. VFR and power to the nonflight instruments would be lost
D. the fire presents no danger to life

20. If the cargo door will not open for bailout, what step should you take?

A. Jettison the door
B. Open the ramp
C. Jettison the cockpit windows
D. Jettison the cabin windows

21. The cockpit auxiliary flotation system release handle is located _____.

A. on the right side of lower radio console
B. on the left side of lower radio console
C. aft and above the copilot's seat
D. below the copilot's sliding window

22. The sea anchor is deployed from the _____.

A. cargo door
B. pilot's window
C. copilot's window
D. avionicsman's window

23. During water egress procedures, when is the seat belt released?

A. Before the landing
B. On water contact
C. After complete immersion
D. Only on command

24. To gain access to the outside release handle for the cockpit and left search windows, you must _____.

A. pull out on the tab
B. remove the protective cover
C. turn the handle
D. press on the end of the handle

25. How many hand-operated CO_2 fire extinguishers are carried on board the helicopter?

A. Two
B. Three
C. Four
D. Five

26. The ice that cannot be swept from aircraft surfaces and controls may be removed by _____.

A. scraping
B. de-icing fluid
C. a vacuum de-icer
D. cold soaking

27. In hot weather operations and if weather permits, which opening(s) should be closed when parking the helo?

A. Cargo door only
B. Ramp only
C. Pilot's window only
D. Both cockpit windows

28. The MOST effective way to eliminate smoke from the helo is through the _____.

A. cabin door
B. cockpit windows
C. cabin door and cockpit windows
D. heater/ventiliation system

29. If it is necessary to abandon the helo, who directs the cabin evacuation and provides the raft?

A. Pilot
B. Copilot
C. Avionicsman
D. Flight mechanic

30. When deploying the anchor, you should attach the snap hook of the anchor line to the _____.

A. eye of the bow line
B. ring in the eye of the bow line
C. deck fitting closest to the cabin door
D. eye bolt just below the copilot's window

31. Where is the red snap hook of the sea anchor connected for deployment?

A. Eye of the bow line
B. Ring in the eye of the bow line
C. Copilot's pedal adjuster
D. Any structural point near the cargo door

32. The cockpit sliding windows are normally operated by a hand latch located in the _____ of the window frame.

A. aft bottom corner
B. forward bottom corner
C. forward top corner
D. forward middle

33. The left search window is jettisoned by _____ on the emergency release handle and _____ on the window frame.

A. pushing forward - pulling in
B. pushing forward - pushing out
C. pulling aft - pulling in
D. pulling aft - pushing out

34. Where is the cockpit fire extinguisher located?

A. Behind the copilot's seat
B. Behind the pilot's seat
C. On the floor between the seats
D. Below the aft end of the radio console

35. In cold weather operation below -29°C, the APU should be shut down if its acceleration hangs between 76% and 85% for more than _____ seconds.

A. 3
B. 6
C. 10
D. 15

36. To prevent the smoke from venting through the cockpit, you should first ensure that the _____.

A. cockpit windows are opened
B. cabin door is opened
C. cockpit vent switch is turned on
D. cabin vent switch is turned on

37. If time permits before a ditching, what action should you take?

A. Open the cabin door and ramp
B. Close the cabin door and ramp
C. Remove and stow the cabin compartment windows and open the cabin door
D. Deploy the auxiliary flotation bags

38. The anchor system consists of an anchor and _____ feet of line.

A. 50
B. 100
C. 150
D. 200

39. What is the next step after throwing the sea anchor overboard?

A. Disconnect the red snap hook
B. Pull the rip cord
C. Release the anchor line
D. Secure the rotor

40. The cockpit window's inside manual emergency release handle is located _____ of each window.

A. below the forward-lower corner
B. below the aft-lower corner
C. below the bottom center
D. aft of the aft corner

41. The cargo door emergency release handle is located _____ of the door.

A. on the forward middle portion
B. above the middle portion
C. on the inside-top center
D. on the aft-upper corner

42. The cabin fire extinguisher is located _____.

A. behind the radio seat on the floor
B. below the step at the cockpit entrance
C. on the right side above the ramp
D. on left side forward of the aft ramp

43. If the OAT is between freezing and -25°C., the battery must be removed and placed in a heated room if the aircraft is to remain outside for more than _____ hours.

A. 2
B. 4
C. 8
D. 12

44. What is the MINIMUM recommended bailout altitude?

A. 200 feet AGL
B. 500 feet AGL
C. 1,000 feet AGL
D. 1,500 feet AGL

45. Where is the cabin auxiliary flotation release handle located?

A. Right side between 2nd and 3rd windows
B. Left side between 2nd and 3rd windows
C. Left side of cockpit entrance door
D. Above the hoist throttle control valve lever

46. When the helo is being towed on water, the speed must NOT exceed _____ knots.

A. 4
B. 5
C. 8
D. 10

47. The cockpit window's outside release handle is located _____ of each window.

A. below the forward-lower corner
B. below the aft-lower corner
C. below the bottom center
D. aft of the aft corner

48. Where are the cargo compartment's jettisonable windows located?

A. First set aft of the cockpit
B. First and second sets aft of the cockpit
C. First set forward of the ramp
D. One over each sponson

49. Where are the cabin first aid kits located?

A. One above ramp, two on left side, and two on right side
B. One on forward wall, two on left side, and two on right side
C. One on forward wall, one above ramp, one on left side, and two on right side
D. One on left side and four on right side

50. Which procedure is incorrect when securing the helo in cold weather?

A. Chock wheels and release parking brake
B. Fill fuel tanks
C. Clean struts with hydraulic fluid
D. Set collective friction lock on

ANSWERS TO SELF-QUIZ #2

QUESTION	ANSWER	REFERENCE	QUESTION	ANSWER	REFERENCE
1	B	2-1	26	B	2-9
2	A	2-3	27	D	2-10
3	A	2-3	28	C	2-3
4	A	2-4	29	D	2-3
5	B	2-6	30	A	2-4
6	B	2-7&-12	31	D	2-5
7	D	2-7	32	B	2-6
8	C	2-8	33	B	2-7
9	B	2-10	34	B	2-7
10	D	2-1	35	B	2-9
11	D	2-3	36	B	2-3
12	D	2-3	37	C	2-3
13	B	2-4	38	C	2-4
14	C	2-6	39	B	2-5
15	C	2-7	40	A	2-6
16	A	2-7	41	C	2-7
17	B	2-8	42	C	2-7
18	C	2-10	43	B	2-10
19	B	2-1	44	C	2-3
20	A	2-3	45	B	2-4
21	C	2-4	46	A	2-5
22	A	2-5	47	B	2-7
23	C	2-6	48	D	2-7
24	D	2-6	49	D	2-8
25	A	2-7	50	D	2-10

RESCUE PROCEDURES
(Section 1)

Reading Assignment: 3
Pages 3-1 through 3-22

OBJECTIVES

To sucessfully complete this assignment, you must study the text and master the following objectives:

1. Describe the function of the hoist.
2. State the operating characteristics of the rescue hoist.
3. Describe the operation of the controls for the rescue hoist.
4. Describe the hoist shear circuit test procedures.
5. State the operating procedures for a standard hoist.
6. State the items on the rescue checklist.
7. Define the terms "COMMANDS" and "ADVISORY REPORTS."
8. Describe the operating procedures for a trail line hoist.
9. State the purpose of a trail line hoist.
10. Define each voice report and state the correct report for a given hoist situation.
11. Explain the two methods, indirect and direct, of delivering the portable salvage pump.
12. Describe the steps that can be taken to prevent a hoisting emergency.
13. State the hoisting emergency procedures.

INTRODUCTION

The flight mechanic, as well as the avionicsman, must be well versed in the use of the rescue hoist, hoist pharaseology, hoisting procedures, and the rescue platform. Your knowledge and use of the subject material will help you become a more efficient hoist operator. If you know the hoist operation, the rescue procedures, and are aware of the pitfalls, your chances of making an error-free rescue will greatly improve. During a rescue attempt, there are enough unforeseen problems to cause you trouble with out the basic procedures becoming a burden too. In other words, if you know the standard hoist procedures and hoist operation (basics), when something out of the ordinary occurs, you can devote your full attention to the problem and adjust to it with ease. The rescue should then be highly successful.

The next two sections are devoted to the rescue hoist operation, hoisting procedures, and some do's, don'ts, and emergency procedures. Because of the procedure similarities, the cargo sling and ADAPTS procedures are also covered.

RESCUE HOIST

GENERAL

The hydraulic rescue hoist is suspended on a fixed truss over the cargo door and has a lifting and lowering capacity of 600 pounds.

The hoist contains 240 feet of usable cable, which terminates in an open-throat hook used for attaching equipment. The hoist also incorporates a load-holding brake, which locks automatically when the hoist stops due to normal stoppage, loss of hydraulic pressure, or hoist motor failure. Microswitches turn off the hoist when the cable is reeled completely in or out (NOT if override used). The last 20 feet of cable is painted in a pattern of 2-inches red and white alternating stripes to provide a visual warning that the cable is nearly unwound. An electrically operated cartridge-type guillotine, controlled by switches in the cockpit and hoist operator's position, may be used to cut the cable at the hoist in case of emergency. The rescue hoist may be electrically controlled from either the cockpit or the cabin. If an electrical failure occurs, a manual override valve will provide for emergency hoist operation.

CONTROLS (Figure 3-1)

Master Switch

A three-position switch labeled HOIST MASTER, with positions marked CREW, OFF, and PILOT, is located on the cockpit overhead switch panel. When the switch is placed in the CREW position, the rescue hoist may be operated only by a crewmember at the hoist operator's position, using either the rescue hoist control switch or the rescue hoist throttle control. When the switch is in PILOT, only the pilot may operate the hoist by using a switch on the pilot's collective pitch lever grip. The OFF position renders the hoist inoperative from any station.

Throttle Control Valve

The hoist operator's primary hoist control is the throttle control valve lever located on the aft side of the cargo door opening. The throttle is spring-loaded to the off position, and a detent provides a positive lock to maintain the throttle in the off position. The throttle control positions are marked UP and DOWN. Moving the throttle UP will raise the cable, and moving the throttle DOWN will lower the cable. The cable speed is proportional to the handle travel and will vary from 0 to approximately 200 feet per minute (fpm). Limit switches electrically stop the hoist when the cable reaches full up or down positions. An intermediate limit switch automatically limits the cable speed to a maximum of 100 fpm when the cable is within 5-7 feet of full up or down.

Hoist Operator's Control Switch

The hoist operator's control switch is on a hand grip bracket over the cargo door opening. The switch panel is labeled HOIST, and the switch has positions marked UP, OFF, and DOWN. The switch operates the hoist at a fixed rate of 100 fpm. The switch will automatically operate as discussed before.

Pilot's Control Switch

The pilot's control is a rocker switch located on the forward side of the pilot's collective pitch strick grip. The switch is labeled HOIST, on the aft end of the stick, with positions marked UP and DOWN. The switch is spring-loaded to the OFF position. The hoist will operate at a fixed rate of 100 fpm, and the limit switches will automatically function. The copilot has no control of the rescue hoist.

Manual Override

If an electrical failure occurs, two buttons on the four-way solenoid valve may be used to operate the hoist. The valve is located directly above the throttle control lever. The button marked UP will raise the cable, and the marked DOWN will lower the cable. The hoist operator must depress the appropriate override button and move the throttle control out of its neutral position to initiate and maintan hoist operation. When operating the manual override valve, the hoist operator must wear gloves because the valve becomes very hot.

CAUTION

With loss of electrical power to the hoist circuits, the intermediate and end limit switches are inoperative. In manual, the hoist is capable of operating above 100 fpm and all safety devices are inoperative. Therefore, be extremely cautious when operating near the cable extremities.

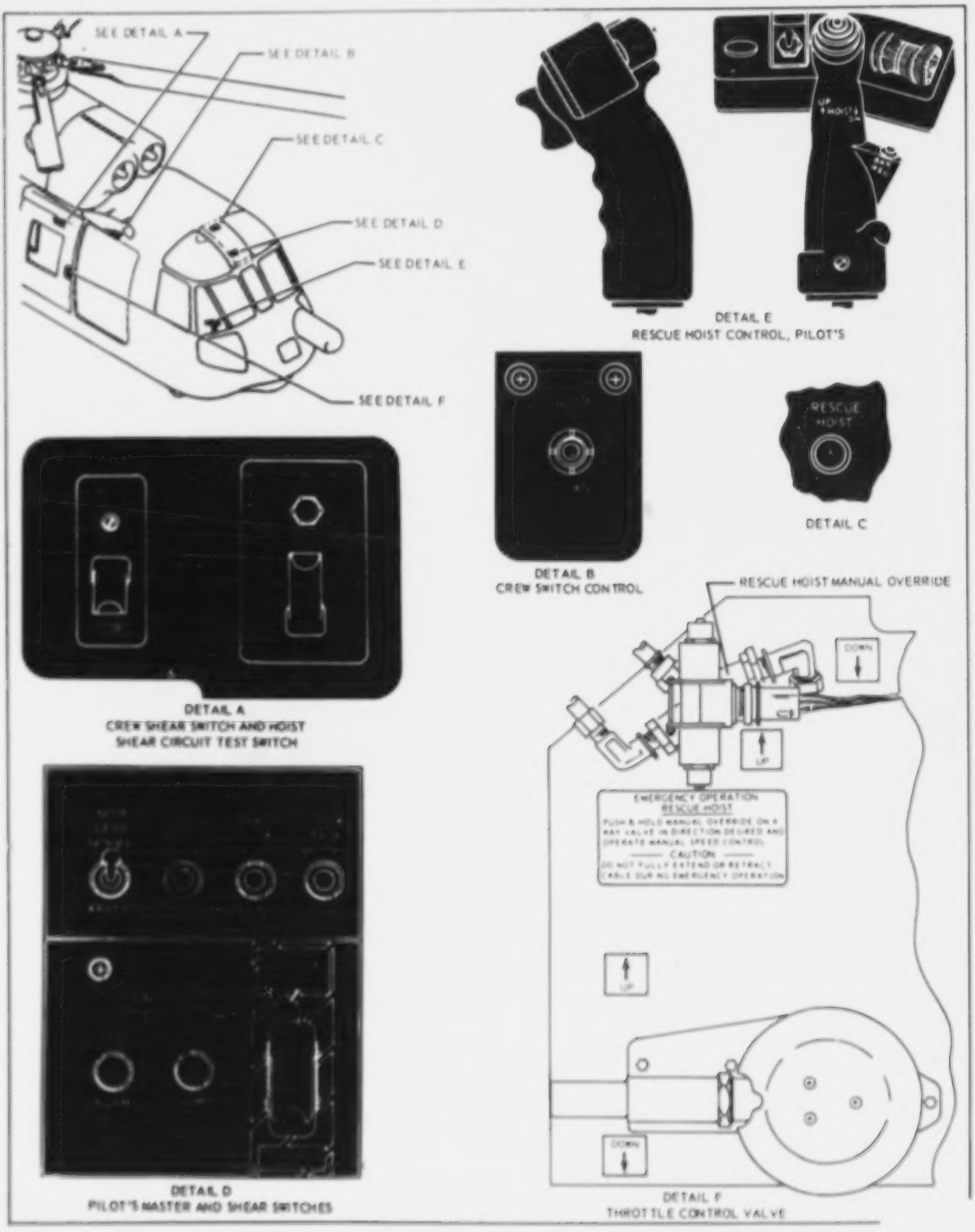


Figure 3-1. - Rescue Hoist Controls.

HOIST SHEAR

Circuit Test Panel

A hoist shear circuit test panel, marked HOIST SHEAR CIRCUIT TEST, is mounted aft of the cargo door. The panel provides a means to test the hoist cable shear circuit. A green light is located above the guarded test switch. The guarded switch is marked TEST and FIRE.

Cable Shear Switch

There is a guarded HOIST CABLE SHEAR switch on the cockpit overhead switch panel and another located aft of the cargo door to the left of the shear test switch. Lifting the guard and actuating the switch in the cockpit will operate the guillotine that will cut the cable regardless of the position of the hoist master switch. The shear switch at the cargo door will operate only when the hoist master switch is in the CREW position.

Test Procedures

To prevent accidental shearing of the hoist cable, make sure the pilot's and the hoist operator's shear switches are OFF.

1. Apply electrical power.
2. Hoist circuit test switch to TEST.
3. Hoist master switch to CREW.
4. Open hoist operator's hoist cable shear switch guard. Momentarily place switch to SHEAR and observe the green light. If the light illuminates, shear circuit OK.
5. Close hoist operator's hoist cable shear switch guard.
6. Hoist master to PILOT.
7. Repeat steps 4 and 5 using the pilot's hoist shear switch.
8. Hoist master switch to OFF.
9. Hoist shear circuit test switch to fire and close the guard.
10. Safety wire switch guards with light copper wire. (Hoist shear circuit test switch and hoist operator's and pilot's shear switches.)

HOIST PROCEDURES

Most SAR hoists are made from some type of floating vessel. Therefore, the procedures or type of hoists discussed in this assignment will deal with boat hoists. However, the hoist procedures for one type of hoist are easily adaptable to another type, such as ground or water.

The success of any hoist is determined by the prehoist activity. A good hoist requires close coordination and cooperation between the pilot and hoist operator and the use of standard rescue procedures. Coordination begins with good communication. Both the hoist operator and pilot must know what is going to happen and how. The pilot's briefing is the major method of passing the information. Before beginning the approach and after evaluating the hoist sight, the pilot will give the briefing. The briefing should cover the point of the hoist, type of hoist, rescue device to be used (figure 3-2), altitude, emergency procedures, and any changes or deviations from standard procedures. As the hoist operator, you should supply inputs to the briefing. If you disagree with the type of hoist or equipment to be used, make your recommendations. But, remember, the final decision belongs to the aircraft commander (pilot).

STANDARD HOIST

The standard hoist is the simplest and most expeditious method of recovering or delivering personnel and equipment from, or to areas where a helicopter cannot land. The standard hoist is the basis for all hoist operations. The name "standard hoist" refers to the method of delivering the rescue device. Usually accompanying the hoist method is the name of the rescue device, e.g., standard basket hoist and standard sling hoist (figure 3-3). For discussion purposes, this assignment will use a standard basket hoist to a boat. To use any other rescue device, just replace the word "basket" with the desired device's name.

Prehoist

After the briefing, the pilot will advise the hoist operator to complete the rescue

Figure 3-2. - Rescue Devices.

checklist. A checklist is to be posted in each helicpoter at the hoist operator's position. The rescue checklist consists of, but is not limited to:

1. Conduct crew briefing.
2. Check flight mechanic and avionicsman hot mic (pilot and copilot respond).
3. Check for condition and rigging of rescue device (basket, sling, platform, etc).
4. Don and adjust the aircrew rescue harness.
5. Request permission to open up and hoist power.
6. Rig the rescue device. (The rescue device should be rigged after establishing a stable hover

Figure 3-3. - Sling Hoist.

because the device may inhibit egress. If possible, the hoist operator should be strapped in with the seat facing forward during the approach to a hover.)

7. Check pilot's and crew's radio switches.

8. Report, "RESCUE CHECKLIST COMPLETE, READY FOR ____.

When the pilot requests the rescue checklist to be completed, the voice procedure should be as follows: (P=pilot, HO=hoist operator, CP=copilot).

P: "Perform rescue checklist for a standard basket hoist."

HO: "Roger."

HO: "On hot mike, how do you read?"

P: "Loud and clear, how me?"

HO: "Loud and clear."

CP: "Loud and clear, how me?"

HO: "Loud and clear; request hoist power and permission to open up."

P: "You have hoist power; open up (or stand by, as the situation dictates)."

HO: "Rescue checklist complete, ready aft" (figure 3-4).

Before starting the hoist, communications should be established with the vessel. If communications cannot be established, drop a message block, use hand signals, the chalkboard, or the loud hailer. Have the vessel lower and stow all antennas, booms, rigging, and loose gear.

Extreme caution must be used when hoisting from a small boat or a raft. There is a great danger of capsizing the small vessel with the rotor downwash (figure 3-5). This is particularly true if the vessel is unable to maintain way. A successful hoist can generally be performed if the combined boat speed and relative wind exceed 15 kts. However, a broadside approach can still capsize the vessel.

The pilot will bring the helo into a hover about 15 to 20 yards short of the vessel. After making minor adjustments and is satisfied that all is ready, the pilot will command, "GO ON HOT MIKE." The hoist operator will now go on hot mike, start the basket down, and give important advisory reports as to the postion of the basket or any other important information (figure 3-6, 3-7).

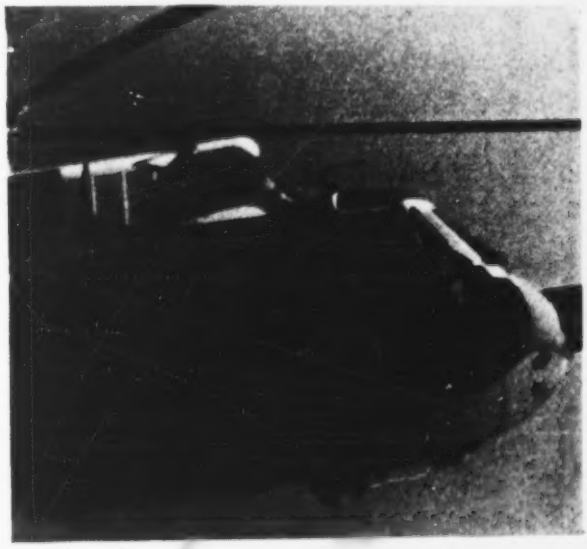


Figure 3-4. - Basket Rigged.

Figure 3-5. - Be careful of Rotor Wash.

NOTE:
The terms "COMMANDS" and "ADVISORY REPORTS" are defined in the HOISTING PHRASEOLOGY portion of this assignment.

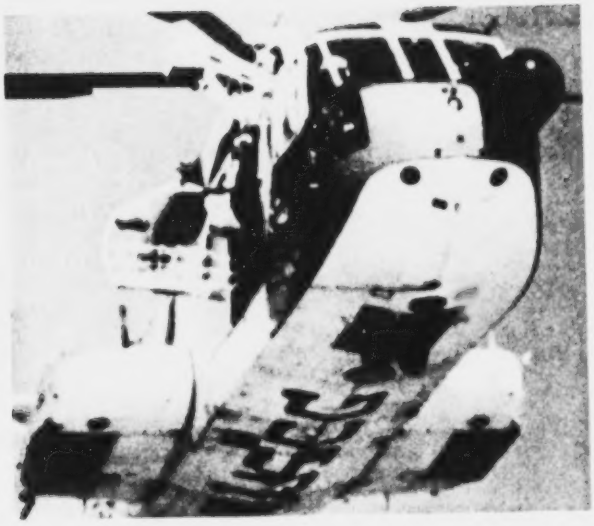


Figure 3-6.-Basket Going Out Door

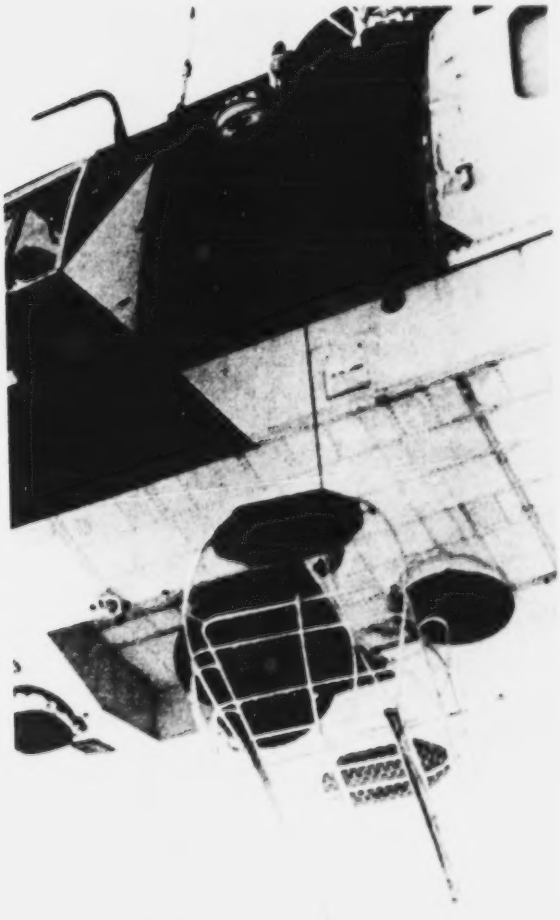


Figure 3-7 - Basket Below Aircraft.

The hoist operator will wear a heavy work glove on the hand used to guide the cable. The glove will help to prevent cuts and burns on the hand. Whenever possible, one of the helment visors should be down to protect the eyes. If pendular action or rotation of the rescue device is not quickly stopped, either one may increase to an unmanageable and dangerous condition. The pendular action may be dampened by moving the cable in the opposite direction to the movement of the rescue device. The rotation of the device, if detected early, can be stopped by rotating the cable in a 1 or 2 foot diameter circle in the opposite direction to the rotation.

Before delivering the rescue device directly to a person, dip the device in the water or ground it. Static electricity buildup occurs rapidly and can produce quite a shock.

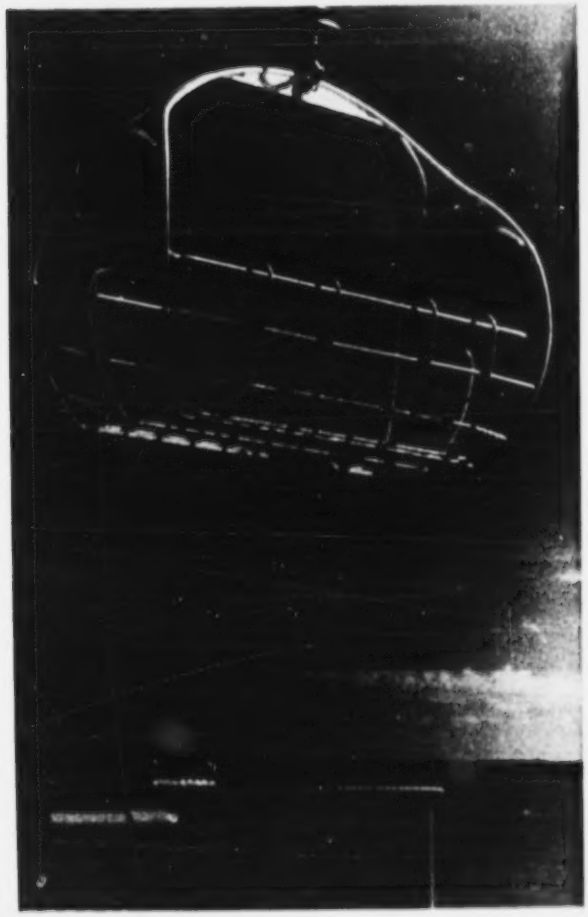


Figure 3-8. - Over Hoist Sight.

The electricity must be discharged as near to the delivery point as possible to eliminate a new buildup. Use caution when discharging. Do not ground the hoist when near a fuel spill.

When the pilot is ready to move in for the hoist, "CONN ME IN" will be given. The hoist operator will start giving commands to position the helo directly over the hoist sight (figure 3-8). At the same time, it is necessary to continue with the advisory reports and deliver the basket to the deck of the vessel. Use great care to maintain positive clearance from the vessel's antennas and rigging.

On Deck

When the basket is on deck, the pilot must hold a steady hover over the boat. Most of the time, the pilot cannot see the vessel and will not have a visual reference. The pilot will rely entirely on the commands and advisory reports given by the hoist operator. For safety purposes, the cable should have some slack so that the basket will not be jerked off the deck due to pitch and roll of the vessel or air turbulence.

There are times when the boat crew will remove the rescue device from the hoist hook. Do not allow the crew to connect or secure the hoist cable to any part of the vessel. But if this should happen, immediately run out slack, inform the pilot, and attempt to have the boat crew release the cable. If the attempts to free the cable are unsuccessful and the helo is in danger, the shear switch may have to be used. The normal procedure for disconnecting the hook from the rescue device is to move the helo left and aft, away from the boat. Then, when all is ready, move the helo back over the boat, relower the hook, reconnect the hook, and finish the hoist.

Retrieval

When the person being hoisted is safely in the basket (figure 3-9), guide the helocopter to a steady hover directly above the hoist sight. Remember, the pilot probably cannot see the sight. Therefore, continuous commands and advisory reports are needed. Take the slack out of the hoist cable and advise the pilot "PREPARE TO TAKE THE LOAD." The pilot now can prepare for the added weight of the basket and survivor.

Figure 3-9. - Man in Basket.

Figure 3-10. - Taking the Load.

When the slack is out of the hoist cable and the cable is starting to take a strain, report, "TAKING A LOAD" (figure 3-10). Smoothly lift the basket clear of the deck. Once the basket is clear of the deck and all

obstructions, report, "BASKET CLEAR OF VESSEL, CLEAR TO MOVE LEFT __FEET." Give the pilot the necessary commands to move the helicopter to a position designated during the briefing (normally left and aft of the vessel) (figure 3-11).

Figure 3-11. - Clear to Move Left.

It is important to move the helo clear of the boat as soon as possible to prevent serious injury to personnel or damage to the boat if an engine failure occurs. At the same time, the pilot will have a visual reference and can maintain a more stable hover.

The commands should continue until the pilot has visual contact with the vessel and reports, "CEASE COMMANDS." Stop giving commands, but continue with the advisory reports. The pilot may continue to move the helo clear of the vessel. If the hoist was a high one the pilot may decrease gradually in altitude to keep the basket close to the water and provide a safer hovering altitude.

This portion of the hoist, from the time the basket clears the deck to the time the basket is clear of the vessel, is a very critical period. There are many things to keep in mind. The basket must not swing or contact any object after clearing the deck. Closely watch all obstructions and helo's altitude. The helo will have a tendency to settle when a load is taken. The seas and the rotor downwash will have an effect on the boat and could cause problems with the hoist. Take your time.

Continue to raise the basket and supply the pilot with advisory reports about the basket's position, aircraft altitude, and any other important item that may occur. When the basket is at the door, report, "BASKET OUTSIDE THE DOOR" (figure 3-12). Bring the basket inside the cabin and report, "BASKET IN CABIN."

Getting the survivor into the cabin may be difficult. The best and easiest method is to position the survivor's back toward the helicopter's door and pull the survivor into the helo backwards. (If the person is in the sling, wrap an arm around the person's waist and pull the person in.) This procedure will reduce the possibilty of a semi-conscious, injured, or panicky survivor from fighting the hoist operator. The rescue device should never be removed from the hoist cable until the survivor is safely inside the cabin and clear of the door.

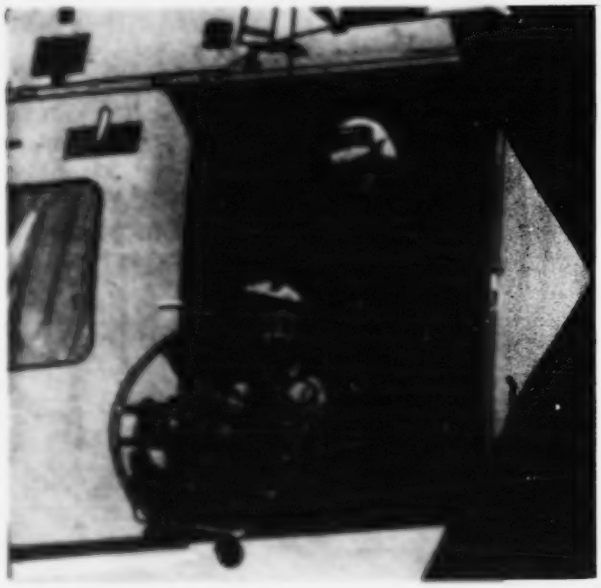


Figure 3-12. - Basket at the Door.

After all the equipment is safely in the cabin, you may report, "GOING OFF HOT MIKE." When the hoist cable has been stowed, report, "SECURE HOIST POWER." When the rescue equipment is safely in cabin, safety strap across the door, the hoist cable

up and hoist power off, report, "READY FOR FORWARD FLIGHT." The pilot will transition to a safe single engine altitude and airspeed.

After all the equipment is stowed, passengers and crew strapped in their seats except for those required to be up and about, report, "CABIN SECURED." The hoist is terminated.

HOISTING PHRASEOLOGY

The effectiveness of a hoist operation depends upon the ability of the pilot and hoist operator to communicate. Standard voice procedures reduce the chance of misunderstanding. The voice reports are mandatory and must be memorized. They must be stated in the correct form. The standard reports are divided into two catagories: Commands and Advisory Reports.

Commands

Commands are given in reference to the fore and aft axis of the aircraft (figure 3-13). They are used to direct the pilot to move the helicopter in a desired direction. Directional commands (right, left) require a distance to be moved in feet. Those directional commands that do not require a distance are EASY, UP, DOWN, and HOLD. The following is a list of the standard commands and their meanings.

FORWARD ___	Move helicopter forward ___ feet.
BACK ___	Move the helicopter backward ___ feet.
LEFT ___	Move the helicopter left ___ feet.
RIGHT ___	Move the helicopter right ___ feet.
UP	Increase the helicopter altitude.
DOWN	Lower the helicopter altitude.
HOLD	Hold the helicopter in a position relative to the target.

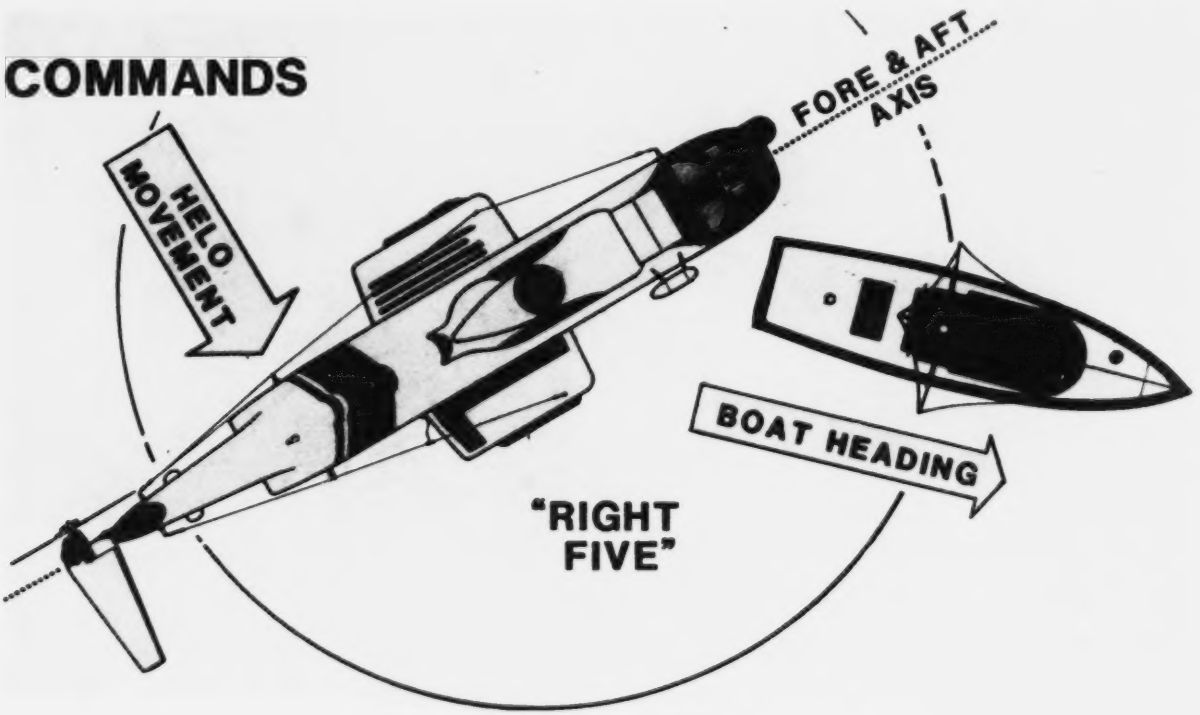


Figure 3-13. - Command Reference.

EASY ___ (left, forward, back, right)	Move the helicopter very slowly in the direction indicated, a very small distance.
FORWARD AND RIGHT ___	Combination COMMAND as discussed later.
GO ON HOT MIKE	The hoist operator begins giving advisory reports.
CONN ME IN	The hoist operator begins giving directional commands and continues giving advisory reports.
CEASE COMMANDS	The pilot no longer requires commands to maneuver.

COMBINATION COMMANDS: Combination commands, such as "FORWARD AND RIGHT 5," may be used in horizontal directions. At certain times, when the pilot is trying to maneuver in a restricted area, a command of "FORWARD 5," followed by "RIGHT 5," will not work. The only way to move is on a diagonal.

Advisory Reports

Advisory reports are used to keep the pilot informed of everything that is occuring during the hoist. The advisory report is information, not a command. Some advisory reports are mandatory and must be reported. The following is a list of the standard mandatory advisory reports and their meanings.

RESCUE CHECKLIST COMPLETE, READY FOR BASKET HOIST	Self-explanatory.
ON HOT MIKE, HAVE TARGET IN SIGHT, BASKET GOING OUT THE DOOR	Hoist operator is commencing the hoist.
BASKET GOING OUT THE DOOR	Hoist operator is beginning delivery of the basket to the hoist area.
BASKET BELOW AIRCRAFT	Basket is below the hull of the helicopter.
BASKET HALFWAY UP/DOWN	Basket is halfway between the helicopter and the suface.
BASKET HOLDING ___ FEET OFF THE WATER	The basket has been lowered to a safe distance from the water and will not be lowered any further until over the hoist area.
BASKET ON DECK	The basket is on the deck of the vessel.
MAN GETTING IN THE BASKET	Self explanatory.
MAN IN THE BASKET	The man is in the basket and ready to be hoisted.
PREPARE TO TAKE THE LOAD	Hoist operator is taking in the slack of the hoist cable and preparing to lift the basket clear of the deck.
TAKING THE LOAD	The hoist operator is lifting the basket with the hydraulic hoist.
BASKET CLEAR OF VESSEL, CLEAR MOVE LEFT ___	ıe basket is well ear of the vessel nd not in danger of fouling in the vessel's rigging. Copilot should clear area to the left. Move the helicopter left so pilot can see the vessel. Commamds are required until the pilot reports "Cease Commands."
BASKET OUTSIDE DOOR	Basket is level with the door and is being brought into the helicopter.
BASKET IN CABIN	Basket is in the cabin and being disconnected from the hoist cable.
GOING OFF HOT MIKE	Self-explanatory.

SECURE HOIST POWER	Pilot secures electrical hoist power. The power is secured to prevent the cable from being inadvertently run out by someone bumping the control or throttle valve falling out of its detent.
READY FOR FORWARD FLIGHT	The cabin area is ready for forward flight. The rescue equipment is safely in the cabin, the safety strap is across the cargo door, the hoist cable has been run up to the limit stop and hoist power has been secured.
CABIN SECURED	All rescue equipment has been stowed; all passengers and crewmembers strapped in except for those required to be up and about the cabin in the performance of their duties.
LOST TARGET	Pilot has lost sight of the hoisting reference.*
TARGET	Pilot can again see the hoisting reference.*
ROGER	To let the pilot know that the hoist operator has heard and understands.
*Hoisting reference-	A visual reference such as a portion of the boat, runway, or platform that will allow the pilot to maintain a stable - hover to complete the hoist. It is normally not pos- sible to maintain visual reference - with the actual position from which the hoist is to be made.

The hoist operator needs to maintain a steady clam voice and a steady commentary, keeping the pilot informed about the hoist progress. If everything is going fine and no commands are required, report "HOLD" occasionally while continuing with the advisory reports.

The advisory reports given in this assignment refer to a basket hoist. If a sling, litter, or pump hoist is to be performed, change the word basket to the type of rescue device used.

TRAIL LINE HOIST

Purpose

The combination of boat size, mast, or antenna obstructions, rigging obstructions, and little or no relative wind may result in a hoist during which the pilot will be unable to see the vessel. Weather conditions might also prevent the pilot from maintaining a high, no-reference hover for any length of time. In these situations, the trail line hoist can be used to simplify the hoist operation. The use of the trail line reduces the time the pilot is required to maintain a precise stable hover, without a reference. The trail line also prevents wide swinging of the rescue device during a high hoist or helps to guide the rescue device when it must be lowered to a restricted location on deck.

Use (Figures 3-14, 3-15)

The HH-3F helicopter normally carries two trail lines: a 105-foot line and a 210-foot line (some units carry more). The lines are made of polyethylene line and are stowed in hanks bound together by rubber bands. The location of the lines and weights in the helicopter is determined by each station.

Figure 3-14. - Trail Line and Weight.

The trail line weight is attached to the end of the trail line without the weak link. The weak link is a safety device, normally made of thin line, which protects the helo by NOT allowing more than 300 pounds of force to be applied to the trail line. If more is applied, the weak link will part. The end of the trail line WITH the weak link is fastened to the small eye of the hoist hook for all trail line hoisting evolutions. The trail line is delivered by positioning the helo over the vessel and paying out the weighted line. Do not uncoil the line before use. It will feed out nicely when the line is lowered. Avoid allowing knotted sections of the line to pass out the door because this will reduce the effective length of the line.

The weight will stabilize the trail line in a vertical position below the aircraft. In heavy winds, the trail line will sail. Two weights may have to be used to stabilize the line. The aircraft may have to be jockeyed to deliver the trail line to a precise spot on the vessel. Avoid allowing the trail line to foul high in the rigging.

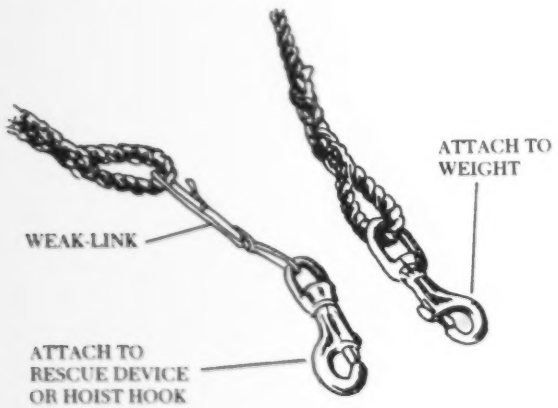


Figure 3-15. - Weak Link.

Procedure

The procedures for a trail line hoist are exactly the same as for a standard boat hoist through the approach and hover astern of the vessel. The length of trail line, hoist sight, and procedure should be covered in the briefing. Complete the rescue checklist when directed by the pilot. Make sure an extra trail line is close by just in case it is needed.

DELIVERY: The weighted trail line is delivered to the vessel using standard hoist procedures. When the pilot states, "GO ON HOT MIKE," you respond, "ON HOT MIKE, HAVE THE TARGET IN SIGHT, TRAIL LINE GOING OUT THE DOOR" (figure 3-16). Continue to give advisory reports on the position of the trail line much the same as with the standard basket hoist. When the pilot states, "CONN ME IN," start giving commands to position the helo over the hoist sight. During this phase of the hoist, the pilot may lose sight of the vessel and will have to rely entirely on you for information. If sight of the vessel is lost, the pilot should report, "LOST TARGET." You should respond, "ROGER." When the sight of the vessel is regained, the pilot should report, "TARGET." Again, you should reply, "ROGER."

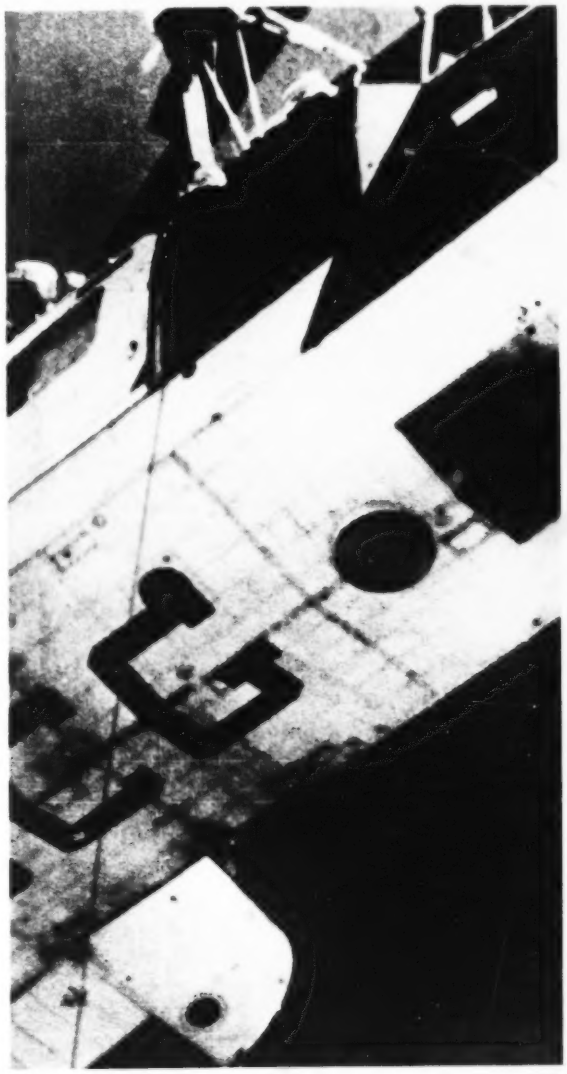


Figure 3-16. - Trail Line Going Down.

Do not attach the trail line to any part of the helicopter during this phase. The line must be delivered by hand and held by hand. The line will be connected ONLY to the hoist hook or rescue device just before the rescue device goes out the door. If the aircraft suddenly moved left or if the distance between the helo and the boat suddenly increased and the trail line was connected too soon, the basket would be jerked out the door and probably take you with it. Severe aircraft damage could occur (figure 3-17).

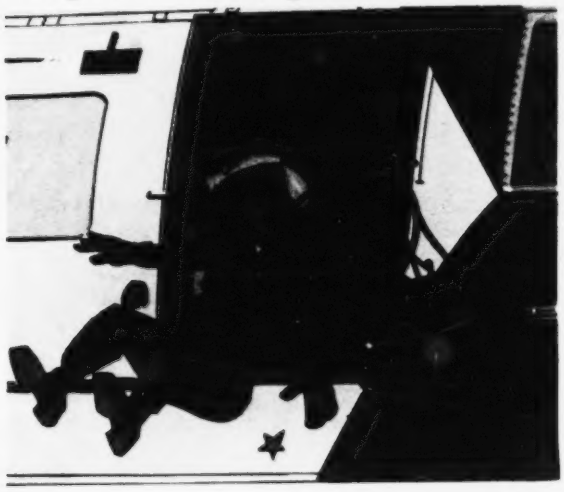


Figure 3-17. - Connect Weak Link at Proper Time.

ON DECK: Once the trail line is on the vessel and the boat crew is tending it, the hoist operator will report, "TRAIL LINE ON DECK." Then give commands to direct the pilot clear of the vessel while paying the rest of the trail line. When the pilot has good visual contact with the vessel and no longer wants commands, the pilot will state, "CEASE COMMANDS." Stop giving commands and continue with the advisory reports.

The rescue device will be delivered to the boat from the helicopter's position, left and aft of the vessel. Connect the weak link to the hoist hook small eye only and report, "TRAIL LINE CONNECTED TO HOIST HOOK." Start to lower the basket (figure 3-18). Use the same advisory reports used for a standard basket hoist. As you are lowering the basket, the shipboard crew will use the trail line to guide the basket onto the desired spot (figure 3-19).

RETRIEVING THE EQUIPMENT: When the rescue device is on deck and the survivor is ready for hoisting, report, "MAN IN BASKET." The pilot will get ready for the hoist and direct you to "CONN ME IN." At this time, give the proper commands to position the helicopter directly over the hoist sight. The hoist should be made as vertically from the deck as possible. But, retrieval of the rescue device vertically may not always be possible. Be aware of this and be prepared to recover the device at an angle.

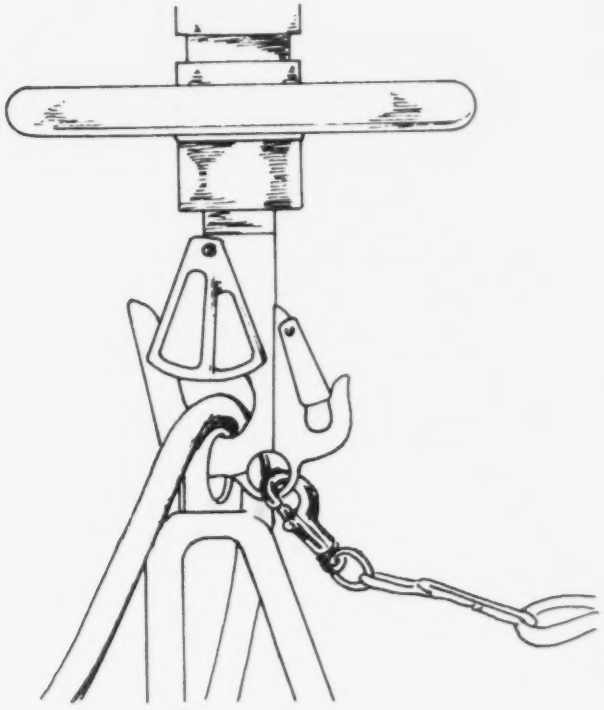


Figure 3-18. - Weak Link Connection.

As soon as the survivor is clear of the deck and all obstruction, report, "BASKET CLEAR OF VESSEL, TRAIL LINE STILL ON DECK, CLEAR TO MOVE LEFT __." Now give the pilot commands to move the helicopter away from the vessel, usually left and back, until the pilot states, "CEASE COMMANDS." This position should be maintained until the survivor is strapped in, the trail line is either retrieved or discarded, and the aircraft is ready for forward flight (figure 3-20).

As the pilot moves the helo away and establishes a position well clear of the vessel, do not permit the pilot to descend until the survivor is safely in the cabin, unless previously discussed. Often a pilot will descend without realizing it once clear of the vessel. If the situation becomes critical and there is danger of the survivor going into the water, give the command "UP."

Once the basket is in the aircraft, continue to give advisory reports for the trail line until it is aboard (figure 3-21). Disconnect the trail line when the rescue device is safely in the cabin. This will help prevent the rescue device and/or the survivor from being pulled out the cabin door. Under adverse conditions, do not hesitate to cut the trail line and throw it overboard. It may be safer not to try to get the line back. Also make sure the trail line is fully recovered or discarded before the hoist hook is disconnected from the rescue device.

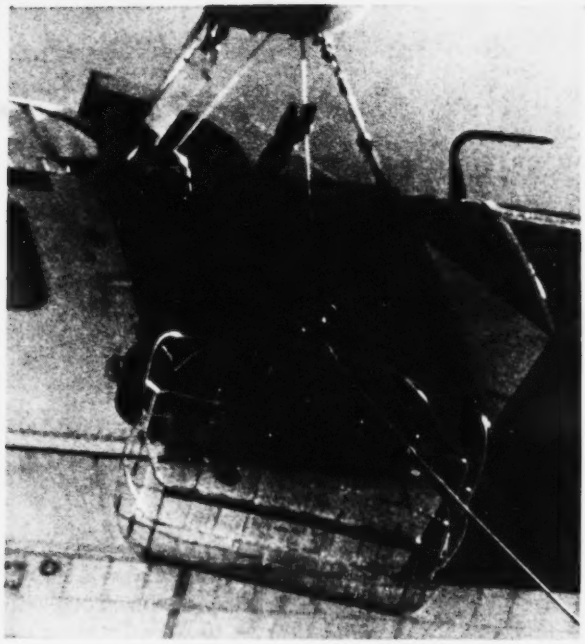


Figure 3-19. - Basket Going Down.

Figure 3-20. - Basket Halfway Up, Trail Line Still on Deck.

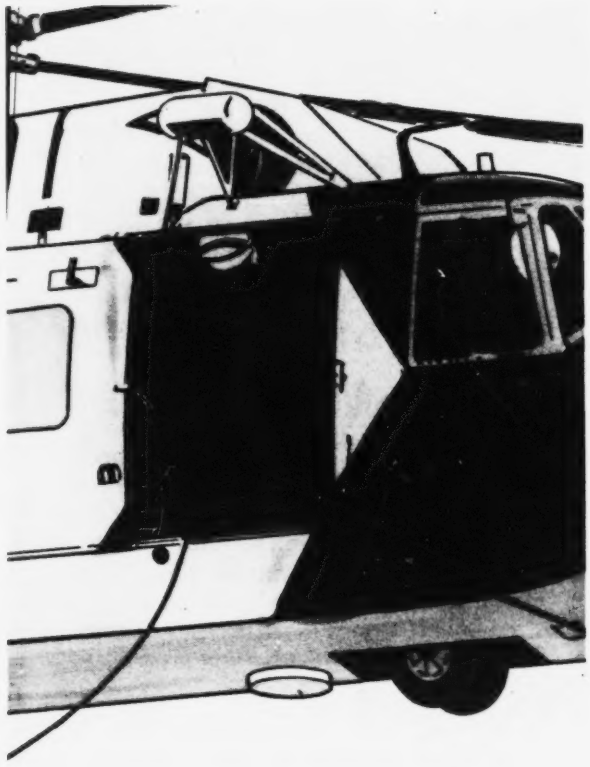


Figure 3-21. - Basket in Cabin, Retrieving Trail Line.

Phraseology

The same commands are used for the trail line hoist that were listed for the standard basket hoist. The advisory reports, for the most part, are the same as for the standard hoist except for some word changes and some new items. To help you visualize the trail line hoist and the changes in the advisory reports, we will list the advisory reports and their meanings in the proper sequence of events for a trail line hoist. The same procedure would be used for a litter hoist except "LITTER" would be substituted for "BASKET."

ON HOT MIKE, HAVE TARGET IN SIGHT, TRAIL LINE GOING OUT THE DOOR	Hoist operator is beginning to deliver a trail line to a vessel.
TRAIL LINE BELOW AIRCRAFT	Trail line weight is below hull of aircraft.
TRAIL LINE HALFWAY DOWN/UP	Trail line weight is halfway between aircraft and surface.
TRAIL LINE HOLDING ___ FEET OFF THE WATER	The weight is a safe distance from the water and will not be lowered any further until over the vessel.
TRAIL LINE ON DECK	Self-explanatory.
TRAIL LINE TENDED	Trail line is being held by deck personnel.
PAYING OUT TRAIL LINE	Hoist operator is paying out extra trail line still in cabin.
TRAIL LINE WEAK LINK CONNECTED TO HOOK (basket, litter, etc)	The basket is ready to go out, and the hoist opeator is making the last minute connection of the weak link to the hoist hook or rescue device.
BASKET GOING OUT DOOR	Self-expanatory.

Use the same advisory reports from this point on for a standard basket hoist until you lift the basket clear of the vessel for retrieval. Remember to report that the trail line is still on the vessel.

BASKET CLEAR OF VESSEL, TRAIL LINE STILL ON DECK, CLEAR TO TO MOVE LEFT ___	A modification of a similar report that reminds the pilot that the trail line is still on deck and to exercise caution when moving left.

Continue with the advisory reports for a standard basket hoist until the basket is back in the cabin. At this point, retrieve the trail line.

BASKET IN CABIN RETRIEVING TRAIL LINE	The basket is in the cabin and the hoist operator is concentrating on getting the trail line aboard.
TRAIL LINE IN CABIN	Trail line is in the cabin and being disconnected from the hoist hook or rescue device.
GOING OFF HOT MIKE	Self-explanatory.
SECURE HOIST POWER	Pilot secures electrical hoist power.
READY FOR FORWARD FLIGHT	see page 3-12
CABIN SECURED	see page 3-12

PUMP DELIVERY

There are two types of salvage pump kits presently in use. One is manufactured by either the Scott Corp. or the Ohler Co. The second pump is made by the Homelite Corp. The Scott/Ohler pumps are stored and delivered in a round metal drum; the Homelite pumps are in a rectangular, plastic

container. Because of the pump's size and weight, the pump could easily cause injury to personnel and damage to the vessel (figure 3-22). This is particularly true if the vessel is pitching and rolling in a rough sea. The situation will determine the method of delivery: INDIRECT or DIRECT.

Indirect Method

The indirect method of delivery is to deliver a weighted trail line to the vessel. The helicopter then moves off and establishes a low hover clear of the vessel (figure 3-23). Attach the trail line to the pump container handle. Do not use the weak link. Since the pump will float, put it in the water. The vessel's crew can pull the pump to the boat through the water and lift it aboard.

Figure 3-22. - Portable Salvage Pump Rigged with Harness.

Deliver the trail line to the vessel in the standard manner, and then give the pilot commands to move the aircraft left of the vessel until the pilot has visual contact with the vessel. The pilot will continue to move the helicopter LEFT or LEFT and BACK of the vessel until the vessel is well clear of the rotor downwash and rotor blades. The pilot will then begin a descent to a low hover over the water. The hoist operator will connect the trail line to the pump container handle when the trail line is payed out. The hoist operator will inform the pilot when the drop pump is ready for delivery. When the pilot states, "put the pump in the water," (figure 3-24) the hoist operator simply pushes the pump out the door. Take care that the pump and the trail line do not become entangled and the trail line does not become fouled on the aircraft.

The boat must be dead in the water to deliver the pump this way. There must be sufficient personnel aboard the vessel to lift the pump aboard. Remember, the pump weighs 100 pounds. This weight would probably be too much for just one person to lift out of the water onto a boat.

Direct Method

If there is some reason why the indirect method cannot be used, the drop pump can be safely delivered directly to the deck of the vessel. Extreme care must be taken to avoid damage to the vessel or injury to personnel on deck. The direct method of delivery is a hoist operation using a trail line. Since this operation is a hoist, the trail line weak link should be attached as described previously. Instead of a trail line hoist using a rescue device, the hoist will be made using a pump (figure 3-25). In this type of hoisting, the helicopter should remain over the vessel during the hoist. Moving left will make it very difficult for deck personnel to retrieve the pump. Once the trail line is delivered, personnel on deck can steady the pump and guide it directly to a spot on deck (figure 3-26). This method is a combination of delivering a

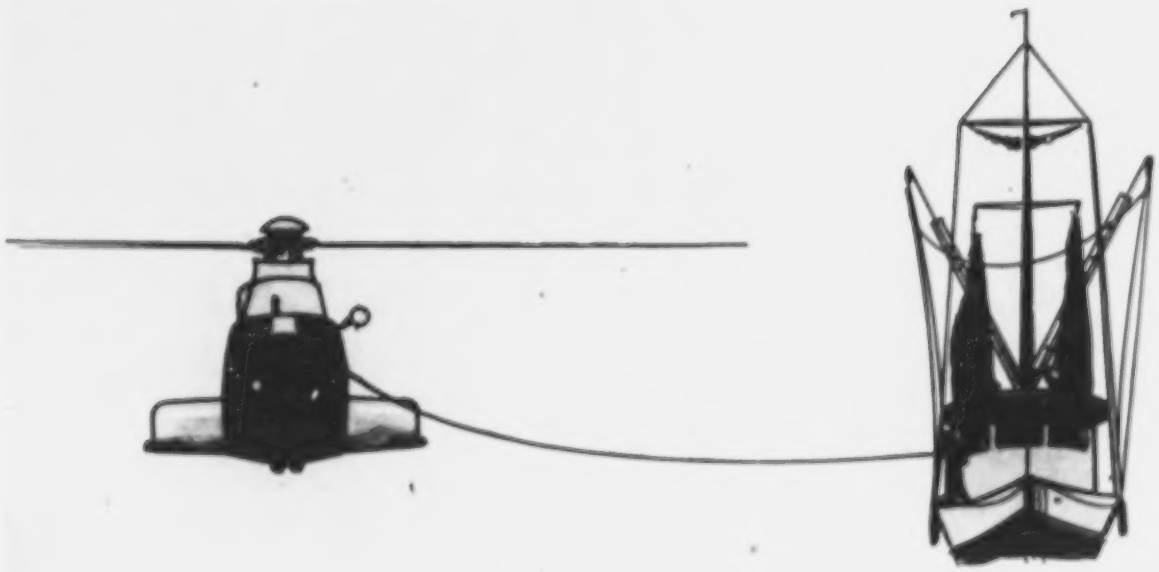


Figure 3-23. - Indirect Pump Delivery.

trail line and a standard hoist. The phraseology is the same as for a trail line basket hoist.

EMERGENCY SITUATION ADVISORY REPORTS

Certain advisory reports are used to indicate difficulty and possibly a dangerous situation. If you find yourself in this situation, tell the pilot IMMEDIATELY! Do not think that you can take care of it yourself. Often the situation can get out of hand, but if you had notified the pilot sooner, the problem might have been solved. When a hoisting situation gets out of hand, it becomes VERY DANGEROUS. Keep the pilot informed. The following is a list of the advisory reports and their meanings.

BASKET SWINGING	The basket is swinging below the helicopter and is difficult to control.
TRAIL LINE IS SAILING	The trail line is sailing aft in the winds; extra effort will be required to deliver the line.
BASKET FOULED (CABLE, etc.)	Basket (cable) has become fouled on the vessel.
SHEAR! SHEAR! SHEAR!	Flight mechanic and copilot activate their respective switches.
BASKET FREE (CABLE, etc.)	Basket (cable) no longer fouled on the vessel.

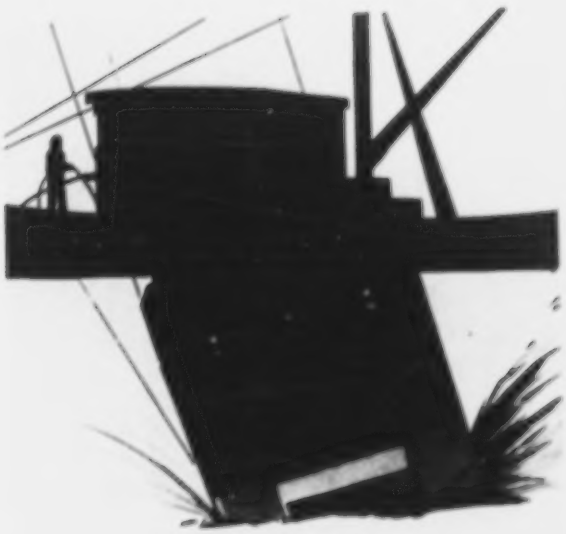


Figure 3-24. - Pump in the Water.

Figure 3-25. - Direct Pump Delivery.

If the basket or litter has to come off the deck in a hurry to prevent fouling or because of an emergency, the pilot can assist by increasing altitude as the hoist operator simultaneously lifts the basket off the vessel. Use this only as an emergency procedure.

Figure 3-26. - Pump on Deck.

HOISTING ADVICE

If you keep the following points in mind, an emergency situation can often be avoided.

Evaluation

Evaluate each hoist before starting. Look the vessel over. Do not allow yourself to be rushed in for a hoist. Check for and make a mental note of all obstructions. Do not forget to keep watch on them during the hoist. Check the deck area for obstructions or loose gear. Loose gear could become airborne and injure someone. Observe the vessel's motion, particularly pitch and roll. Determine if any nonstandard procedures will be required, and if so, talk them over with the pilot BEFORE the hoist.

Brief

Make sure you receive a complete briefing from the pilot before starting the hoist. The pilot should tell you exactly what equipment is to be used and how you will deliver it. There should be no doubt in either the pilot's or the hoist operator's minds about how the hoist is to be accomplished.

Corrective Action

Take corrective action early. Do not allow a potentially bad situation to get out of hand. If the hoist is not going well, report to the pilot before damage or injury occurs. The two of you can work out a solution much better than if only one of you knows there is a problem. A small change in delivery technique may be all that is necessary to solve the problem. Do not hesitate to retrieve the basket, move off, relax, discuss the situation, and then try again.

Anticipate

Do not wait for something to happen or allow yourself to "get behind the aircraft." Allow a lead time on commands. Do not wait for the aircraft to arrive where you want it before you say, "HOLD." If you do, and you have not anticipated the rate of aircraft movement, by the time the pilot brings the aircraft to a stop, you will be well beyond where the aircraft should be.

Inform Pilot

Keep the pilot informed. Clear, timely, voice reports on the hoist progress enables the pilot to stay abreast of your activities. The pilot cannot see anything of the hoist operation, except possibly a very small section of the vessel's bow. The less you tell the pilot, the harder the hoist will be for the hoist operator.

Voice (Figure 3-27)

Do not raise you voice. Maintain a low monotone, no mater what. You will be on hot mike, and all noises will be transmitted throught ICS to pilot's headphones. Keep your mike on you lips to elminate wind noise and to prevent you from becoming difficult to hear. If the pilot is having difficulty hearing you, something may be done that is entirely different from what you want done.

Visual Contact

Always keep the vessel in sight. If you allow the pilot to move the aircraft in such a manner that you lose sight of the vessel, you are asking for very serious problems. If visual contact is lost, immediately inform the pilot, and give the pilot your best estimate of corrective action.

Figure 3-27. Mike Position.

Weak Link

Always use a weak link when attaching a trail line to the hoist hook or rescue device. The only time a weak link is NOT used is for a pump delivery where the pump is to be put into the water with the trail line on the vessel. The hoist is NOT used.

EMERGENCY PROCEDURES

Fouled Cable (Figure 3-28)

If the cable or basket becomes fouled on the vessel or has been secured to the vessel, pay out slack, inform the pilot, and attempt to free the cable. Attempt to have personnel on the vessel assist in freeing the cable or basket. If the aircraft has communications with the vessel, ask the pilot to contact the vessel for assistance in freeing

the cable or rescue device. Be prepared to shear the cable if it becomes necessary.

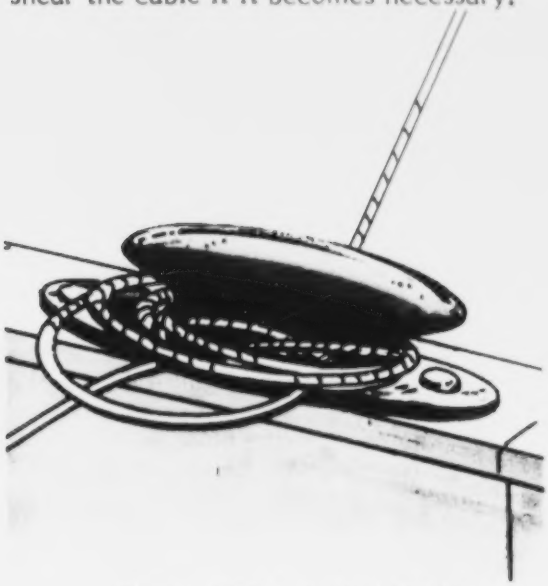


Figure 3-28. - Fouled Cable.

Figure 3-29. - Fouled Hoist Drum.

Hoist Failure (Figure 3-29)

Hoist failure may be caused by electrical failure, hydraulic failure, or fouling of the hoist cable on the drum.

ELECTRICAL FAILURE: If the hoist fails during a hoist operation, visually check the hoist, have the copilot secure hoist electrical power, and then try the manual override. If you are not committed over the vessel (gear on the deck or passing through the rigging) the helicopter crew should stop, check the "hoist" circuit breaker, try one reset if it popped, and continue. If the helicopter is committed or if night conditions exist, check the drum for a fouled cable and then go to manual override. The hoist limit switches are inoperative with the loss of electrical power. The hoist is capable of operating at a speed in excess of 100 fpm in this configuration. Therefore, exercise caution when operating near the cable's extremities and adjust the cable speed accordingly. Do not run the cable all the way up or down with the manual override.

CAUTION

The use of override with a fouled reel or cable can damage and cause possible parting of the cable. If a resistance is met using the override, the operation should be stopped immediately, to prevent further damage.

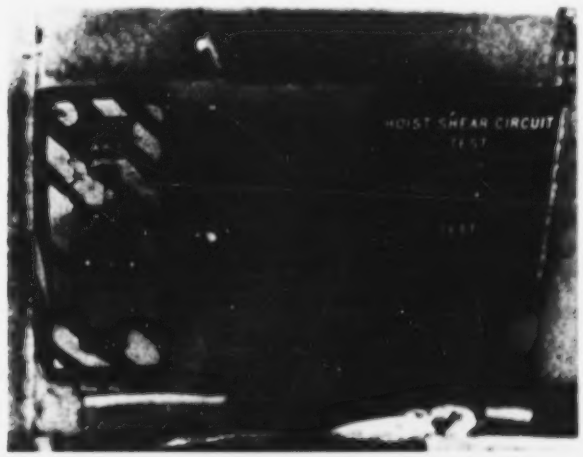


Figure 3-30. - Hoist Shear Switch.

Hoist Shear Switch (Figure 3-30)

The hoist shear switch is used to sever the hoist cable with an explosive charge and guillotine apparatus to prevent or minimize damage to the helicopter or the vessel. If, during a hoist evolution, the hoist operator

feels that the situation has progressed beyond the limits of safety and the hoist should be sheared, report, "SHEAR! SHEAR! SHEAR!" and throw the shear switch. The hoist operator's shear switch is hard to reach; upon hearing the command to shear, the copilot will actuate the shear switch in the cockpit.

Use this procedure ONLY in the most extreme situations where aircraft and personnel safety depend on the immediate shearing of the hoist cable to avoid disaster. Except in the most extreme situations, the pilot will make the decision to shear, upon recommendation from the hoist operator. Normally, the copilot will be able to shear most expeditiously, but when the pilot says, "SHEAR! SHEAR! SHEAR!" it does not matter who actually throws the switch, as long as someone does.

NOTE

Keeping the pilot informed will prevent many situations that result in the necessity for shearing.

ICS Failure

ICS failure is most commonly caused by the hoist operator's inadvertently pushing in the ICS or HOT MIKE buttons or accidently unplugging the ICS cord. Also, the crewmember's or pilot's helmet may be malfunctioning. Many units carry a headset in the helicopter in case this emergency is encountered. The headset can also be used to talk to a survivor. If an ICS failure occurs, check the HOT MIKE and ICS buttons on the ICS control panel. The hoist operator should get the avionicsman's attention and point to the ears to signify loss of ICS. The avionicsman will notify the pilot. If the hoist is committed and the avionicsman is hoist qualified, the avionicsman will assume the conn. If the avionicsman is not, exchange ICS cords. Do not forget to pull the HOT MIC button on the avionicsman's control panel out. If the hoist is not committed, abort and correct the problem.

SELF-QUIZ #3

1. When the hoist cable is within 5 to7 feet of full up or down, the cable speed is limited to a MAXIMUM of _____.

   A. 200 fpm
   B. 100 fpm
   C. 50 fpm
   D. 20 fpm

2. What is the indication that the hoist shear circuit test checks OK?

   A. Hoist cable remains on the drum
   B. Test light illuminates
   C. Beeper trim jumps the stick
   D. Audio tone is sounded

3. How should you dampen the pendular action of the rescue device?

   A. Run out more cable
   B. Move the cable in the same direction as the movement
   C. Move the cable in the opposite direction as the movement
   D. Take all slack out of the cable

4. When the basket is on deck, what preventive measure should you take?

   A. Move helo to the left and aft of the vessel
   B. Run out some slack in the hoist cable
   C. Ensure that the basket is unhooked
   D. Get the helo as close to the vessel as possible

5. Which command must be accompanied by a distance?

   A. UP
   B. BACK
   C. HOLD
   D. EASY

6. The trail line weak link parts at a MAXIMUM weight of _____ pounds.

   A. 100
   B. 200
   C. 300
   D. 600

7. When the pilot is in visual contact with the vessel and no longer wants commands, what command will be given?

   A. STOP
   B. TARGET
   C. GO OFF HOT MIKE
   D. CEASE COMMANDS

8. What occurs after the trail line is connected to the pump during an indirect delivery?

   A. Helo is maneuvered back over the vessel
   B. Pump is pushed into the water
   C. Pump is connected to the hoist
   D. Pump is lowered to the vessel

9. If the hoist cable becomes fouled on a vessel, what action should you take first?

   A. Decrease helicopter's altitude
   B. Pay out cable slack
   C. Shear the cable
   D. Tell the vessel to stop

10. When using the manual override, you should _____.

    A. never run the hoist at full speed
    B. never run the hoist all the way up or down
    C. always allow lead time when stopping
    D. be extra careful because the shear is inoperative

11. What is the voice report for, "basket has been lowered to 20 feet off the water and will not be lowered any further until the helicopler is over the hoist sight"?

    A. HOLD 20 feet
    B. BASKET STEADY at 20
    C. CLEAR TO MOVE LEFT
    D. BASKET HOLDING 20 FEET OFF THE WATER

12. The function of a hoist is to _____ in an area where a helo cannot land.

    A. deliver equipment only
    B. retrieve people only
    C. deliver and retrieve people only
    D. deliver and retrieve people and equipment

13. The rescue hoist may be operated from the cockpit by the _____.

    A. pilot only
    B. copilot only
    C. pilot or copilot only
    D. pilot, copilot, or jump seat occupant

14. The cargo door shear switch will operate when the hoist master switch is in _____ position(s).

    A. only the CREW
    B. only the OFF
    C. only the CREW and OFF
    D. the CREW, OFF, and PILOT

15. How should you stop the rotation of a rotating rescue device?

    A. Increase cable length
    B. Decrease cable length
    C. Rotate cable in same direction as rotation
    D. Rotate cable in opposite direction as rotation

16. Before lifting the basket clear of the deck, you should _____.

    A. move the helo to the left
    B. use only EASY commands
    C. position the helo directly above the hoist sight
    D. decrease the helo altitude as much as possible

17. Which voice report tells the hoist operator to start giving Advisory Reports?

    A. REPORT
    B. GO ON HOT MIKE
    C. CONN ME IN
    D. YOU HAVE IT

18. Where should the trail line be connected?

    A. Rescue device
    B. Eye of the hoist hook
    C. Small hoist hook
    D. Door strap D-ring

19. During a trail line hoist, what should you do after the survivor is in the basket?

    A. Take the slack out of the cable
    B. Lift the basket clear of the deck
    C. Move the helo over the hoist sight
    D. Disconnect the trail line

20. What is the delivery procedure for a direct method pump delivery?

    A. Trail line and push in the water
    B. Standard hoist
    C. Standard hoist with trail line
    D. Hand pump to vessel from a low hover

21. If a hoist electrical failure occurs during a hoist, how many times should you try to reset the popped circuit breaker?

A. One
B. Two
C. Three
D. Four

22. What is the meaning of the command, "RIGHT 10"?

A. The target is 10 yards to the right
B. The helo is 10 yards to the left of the target
C. Move the helo 10 feet to the right
D. Move the target 10 feet to the right

23. What is the voice report for, "The trail line is being held by deck personnel"?

A. TRAIL LINE HELD
B. TRAIL LINE TENDED
C. TRAIL LINE ON DECK
D. DECK HOLDING LINE

24. The rescue hoist contains a total of _____ feet of usable cable.

A. 140
B. 190
C. 240
D. 290

25. The pilot's and host operator's control switches operate the hoist at a rate of _____.

A. 60 fpm
B. 100 fpm
C. 200 fpm
D. 240 fpm

26. When is the rescue device rigged?

A. Before the approach
B. During the approach
C. Before establishing the hover
D. After establishing the hover

27. At what point during a hoist will the pilot initially state, "GO ON HOT MIKE"?

A. Before executing the approach
B. Before establishing the hover
C. After establishing the hover and all is ready
D. When over the hoist sight and all is ready

28. As soon as the basket is clear of the vessel, you should _____.

A. move the helo clear of the vessel
B. dip the basket
C. ensure a steady hover is maintained over the vessel
D. go off hot mike

29. Which type of voice report keeps the pilot informed about everything that occurs during a hoist?

A. Advisory report
B. Information report
C. Situation report
D. Command

30. Where is the weight attached to the trail line?

A. End without weak link
B. One-quarter point
C. Midpoint
D. End with weak link

31. What voice report should you give after the equipment is secured and passengers are strapped in?

A. GOING OFF HOT MIKE
B. CABIN SECURED
C. READY FOR FORWARD FLIGHT
D. HOIST COMPLETE

32. For the indirect pump delivery method, what, if any, should be the boat's rate of movement?

A. Enough to maintain steerage
B. 5 knots into the wind
C. 15 knots total boat speed plus wind
D. Dead in the water

33. If a hoist electrical failure occurs and you are committed, what action should you take?

A. Try to reset circuit breaker
B. Pull cable in by hand
C. Go to manual override
D. Shear

34. All directional commands are referenced to the _____.

A. boat's position
B. boat's fore-and-aft axis
C. helo's fore-and-aft axis
D. relative position of the helo to the boat

35. What is the voice report for, "The basket is in the cabin and the trail line is outside"?

A. BASKET IN CABIN
B. BASKET IN CABIN, RETRIEVING TRAIL LINE
C. TRAIL LINE STILL ON DECK
D. PULLING IN TRAIL LINE

36. What is the MAXIMUM lifting capacity of the standard rescue hoist?

A. 300 pounds
B. 600 pounds
C. 900 pounds
D. 1,200 pounds

37. For manual hoist operation, the cable speed is _____.

A. fixed at 100 fpm
B. controlled by the manual override valve
C. controlled by the hoist operator's control switch
D. adjusted by the throttle control valve

38. Which item is NOT part of the basic rescue checklist?

A. Check hot mike
B. Request hoist power
C. Request permission to open up
D. Check visor down

39. For safety purposes, the hoist operator should _____ when making a hoist.

A. wear a heavy work glove
B. only have a helmet visor down
C. wear a heavy work glove and have a visor down
D. always kneel

40. At what point is a hoist considered completed?

A. Basket clears the vessel
B. Basket enters cabin
C. Off hot mike
D. Cabin secured

41. Before lifting the basket clear of the deck, you should report, "_____."

A. TAKING THE LOAD
B. PREPARE TO TAKE THE LOAD
C. TAKING A STRAIN
D. LIFT THE BASKET

42. For a trail line hoist, what action should you take when the pilot states, "GO ON HOT MIKE"?

A. Position the helo over the target
B. Complete the host shear circuit test
C. Start the trail line down
D. Select hot mike and wait for another command

43. For an indirect pump delivery, the weak link is _____.

A. not used
B. connected to the pump container handle
C. slipped on the small hoist hook
D. connected to the hoist hook eye

44. To aviod overrunning the target or getting behind the aircraft, you should _____.

A. approach the target no faster than 5 KIAS
B. approach the target as quickly as possible
C. allow lead time for all commands
D. come in high, hover, and decrease altitude

45. What is an incorrect way to eliminate a hoist emergency?

A. Speak in a low monotone voice
B. Make sure you and the pilot know exactly what is going to happen
C. Use the weak link for all trail line hoists
D. Never vary hoist procedures

46. When the helicopter is to be moved a very small distance, what word is combined with the directional command?

A. FEET
B. SLOW
C. SLIGHTLY
D. EASY

47. Which voice report is used when the helo is inadvertently increasing its altitude?

A. YOU ARE CLIMBING
B. DOWN
C. EASY DOWN
D. CORRECT ALTITUDE

48. What is the warning when the hoist cable is nearly unwound?

A. The last 20 feet of cable is red and white alternating stripes
B. The last 20 feet of cable is solid day-glow orange
C. The cable length indicator shows OUT
D. A 1000-Hz tone is generated in the headset

49. For the hoist operator's shear circuit test, what is the next step after electrical power is applied?

A. Shear switch to SHEAR
B. Master switch to CREW
C. Circuit test switch to TEST
D. Test light ON

50. Which item is NOT part of the basic rescue checklist?

A. Don and adjust rescue harness
B. Conduct crew briefing
C. Test hoist shear circuit
D. Report ready

51. What is the reason for dipping the rescue device?

A. Rustproof the device
B. Clean the dirt off before delivery
C. Prevent the device from slipping
D. Discharge the static electricity

52. What is the BEST and EASIEST method to bring a survivor into the cabin?

A. Push away from the door and allow the survivor swing into the cabin
B. Position the survivor's back to the door and pull into the cabin
C. Position the survivor facing the door and pull into the cabin
D. Hold the basket steady and allow the survivor to step into the cabin

53. If no movement is required and your position is satisfactory, you should report, "_____."

A. EASY
B. STAY
C. STEADY
D. HOLD

54. What action should you take after the trail line is on the deck?

A. Attach the line to the hoist hook
B. Move the helo to a predetermined spot away from the vessel
C. Start the basket down
D. Secure hot mike until told to resume

55. For an indirect pump delivery, the FIRST step is to _____.

A. lower the pump with the hoist
B. deliver the trail line
C. put the pump in to the water
D. move the helo clear of the vessel

56. To eliminate wind noise on the ICS, you should _____.

A. keep your mike against your lips
B. hold your mike against your throat
C. put your mike about 1 inch from your mouth
D. stay inside the helicopter

57. When "SHEAR, SHEAR, SHEAR" is reported, who has the authority to throw the shear switch?

A. Pilot only
B. Copilot and pilot only
C. Copilot and hoist operator only
D. Anyone who can reach the switch

58. What is the meaning of the voice report, "BASKET CLEAR OF VESSEL"?

A. Basket is just clear of deck
B. Basket is in no danger of fouling in rigging and is well off the deck
C. Basket is not over the vessel and helo can descend
D. Basket is holding over water and helo is free to move in for hoist

59. What voice report is used when the basket gets caught in the vessel's rigging?

A. DOWN
B. SHEAR, SHEAR, SHEAR
C. HOLD, BASKET SEIZED
D. BASKET FOULED

60. The throttle control valve is used to raise or lower the hoist if the _____ position.

A. rescue host control switch is in the ON
B. hoist master switch is in the CREW
C. hoist master switch is in the PILOT
D. pilot's hoist control switch is in the OFF

61. During the hoist operator's shear circuit test procedure, what is the next step after the hoist master switch is set to CREW?

A. Shear switch to SHEAR
B. Shear circuit breaker OUT
C. Circuit test switch to TEST
D. Test light ON

62. What voice report is used when the pilot wants to receive commands?

A. GO ON HOT MIKE
B. CONN ME IN
C. START COMMANDS
D. MOVE ME OVER

63. The voice reports used to move the helicopter to a desired position are called _____.

A. ADVISORY REPORTS
B. POSITION REPORTS
C. DIRECTIONS
D. COMMANDS

64. Which items is NOT a purpose of a trail line hoist?

A. Reduces over target time
B. Prevents wide swinging of rescue device
C. Keeps static electricity discharged
D. Helps guide the rescue device

65. When is the weak link connected to the hoist hook?

A. Before delivery of the trail line
B. As soon as the line is on deck
C. Only on command from the pilot
D. Just before the basket goes out the door

66. For an indirect pump delvery, what is the next step after the helo hovers well clear of the vessel?

A. Connect hoist hook to pump
B. Connect trail line to pump bridle's D ring
C. Drop pump
D. Attach trail line to hoist hook

67. Which hoisting procedure is INCORRECT?

A. Take corrective action early by solving the problem alone
B. Make mental notes of all obstructions before begining the hoist
C. Always keep the vessel in sight
D. Keep the pilot informed about everything during a hoist

68. The throttle control valve can vary the hoist cable speed from 0 to approximately

A. 100 fpm
B. 150 fpm
C. 200 fpm
D. 300 fpm

ANSWERS TO SELF-QUIZ #3

QUESTION	ANSWER	REFERENCE	QUESTION	ANSWER	REFERENCE
1	B	3-2	35	B	3-16
2	B	3-4	36	B	3-1
3	C	3-7	37	D	3-2
4	B	3-8	38	D	3-5 & 3-6
5	B	3-10	39	C	3-7
6	C	3-12	40	D	3-10
7	D	3-11 & 3-14	41	B	3-8
8	B	3-17	42	C	3-13
9	B	3-20	43	A	3-17
10	B	3-21	44	C	3-20
11	D	3-11	45	D	3-20
12	D	3-4	46	D	3-11
13	A	3-2	47	B	3-18
14	A	3-4	48	A	3-2
15	D	3-7	49	C	3-4
16	C	3-8	50	C	3-5 & 3-6
17	B	3-11	51	D	3-7
18	B	3-12 & 3-13	52	B	3-9
19	C	3-14	53	D	3-10& 3-12
20	C	3-17	54	B	3-14
21	A	3-21	55	B	3-17
22	C	3-10	56	A	3-20
23	B	3-16	57	D	3-22
24	C	3-2	58	B	3-11
25	B	3-2	59	D	3-18
26	D	3-5	60	B	3-2
27	C	3-6	61	A	3-4
28	A	3-9	62	B	3-11
29	A	3-11	63	D	3-10
30	A	3-12	64	C	3-12
31	B	3-12	65	D	3-1 & 3-14
32	D	3-17	66	B	3-17
33	C	3-21	67	A	3-19& 3-20
34	C	3-10	68	C	3-2

SECTION II

Reading Assignment: #4
Pages 4-1 through 4-14

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. State the purpose of the rescue platform.
2. Describe the procedures and precautions for rough and calm water platform recoveries.
3. Explain the voice reports used for platform recoveries.
4. State the function of the cargo sling.
5. State the operating procedures and precautions for the cargo sling.
6. Explain the operation of the cargo sling controls.
7. Describe the use of the personnel ladder as a rescue device.
8. Explain the aircraft modifications required for delivery of the Air Deliverable Anti-Polution Transfer System (ADAPTS).
9. Explain the ADAPTS loading and delivery procedures.

RESCUE PLATFORM

GENERAL

The rescue platform is an effective device used to recover personnel or objects from the water or small boats when a water landing can be made. The platform is designed to permit the flight mechanic to move to the outboard side of the right sponson. There, the flight mechanic can assist mobile survivors or rescue immobile survivors. A rescue platform recovery is usually a safer method of rescue than a hoist when conditions are favorable.

Platform recoveries are divided into calm water and rough water recoveries, depending upon the sea conditions. Each platform recovery is begun by the pilot making a sea and wind evaluation. With this information and thorough observation of the recovery target, the pilot briefs the crew for the recovery. The pilot makes an approach to a hover with the recovery target in the 1 o'clock position outside of the rotor wash pattern. This position gives the pilot and the hoist operator the best view of the target. Rig the rescue platform and complete the rescue checklist at the direction of the pilot. These operations are normally completed before the helicopter begins the approach, but they may be done after the helicopter is established in a hover. For actual pickups, the platform rigging, either upper or lower positions, will depend on the crewmembers

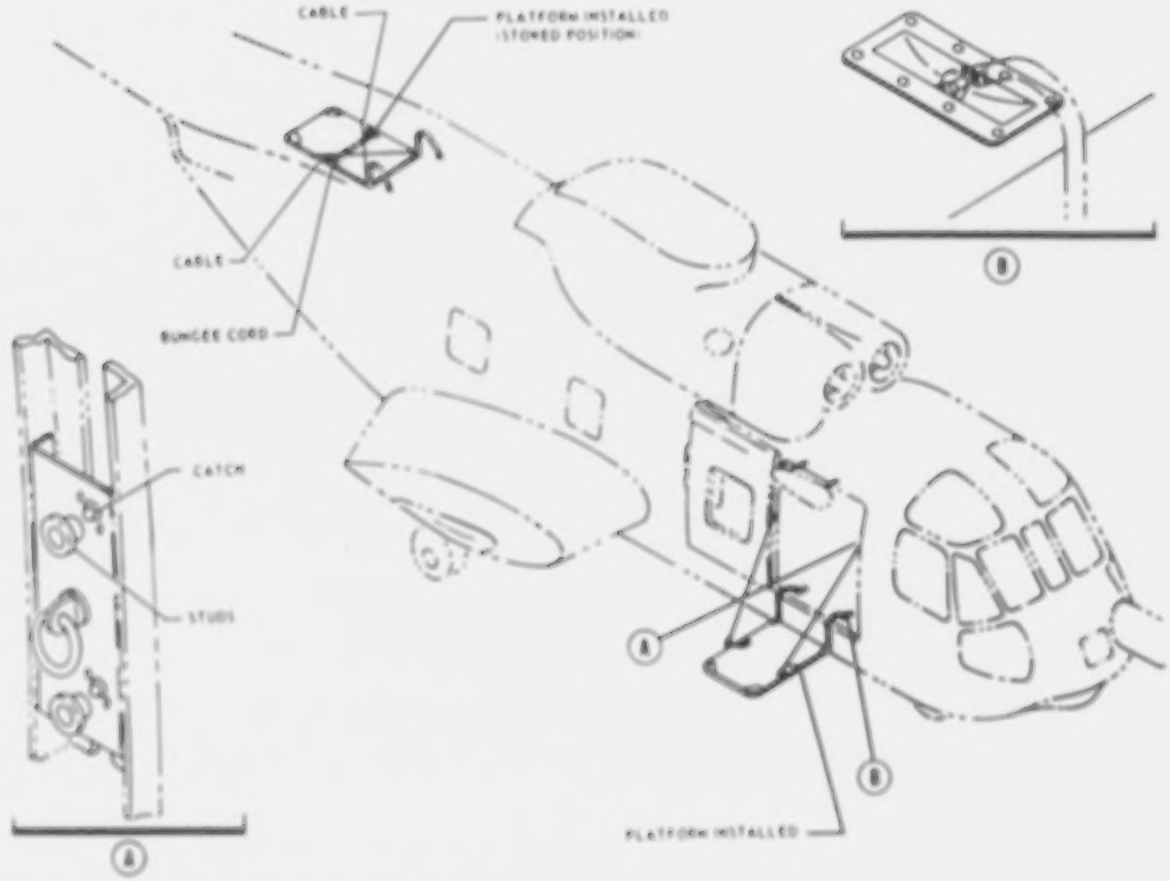


Figure 4-1. - Rescue Platform.

preference and rescue conditions(figure 4-1).

Calm Water Recovery (Figures 4-2, through 4-8)

The rescue platform will normally be used to rescue survivors from sheltered waters or smooth, calm, open sea conditions. After establishing a hover, the pilot will instruct you to open the door and lower the platform. The pilot will now instruct you to "GO ON HOT MIKE" so you can estblish ICS communications. When the pilot directs you to "CONN ME IN," you should begin giving the pilot continuous directional commands and advisory reports. The commands and advisory reports should continue until the pilot states "CEASE COMMANDS" or until the rescue is complete.

Immediately after touchdown, you should position yourself on the edge of the platform with your belt adjusted to permit complete freedom of movement on the platform. You may attach your safety harness to the jumpseat seat belt ring or to the troopseat seat belt ring below the hoist control handle to provide for more freedom of movement.

Figure 4-2. - Platform Rigged.

Figure 4-3. - Alternate Harness Connection.

The survivor should be at the 1 o'clock position outside the rotor downwash when the landing is made. By the use of commands, maneuver the helicopter to bring the survivor alongside the platform. The closure rate must be slow, and it must be closely controlled so that all drift is stopped as the platform approaches the survivor. The drift must be stopped to keep from running over the survivor or to prevent the survivor from drifting under the sponson or hull. If you feel that the closure rate is too fast, immediately tell the pilot. Slower than necessary is better than just a little too fast. If the survivor becomes endangered by the helo, use the command "UP," meaning "establish a hover immediately".

Normally you will use the boat hook to help retrieve the survivor. To prevent rotor damage or blade contact, do not raise the boat hook above the height of the cargo door.

Figure 4-4. - On the water, Forward 20.

Figure 4-5. - Conning the Pilot into Position.

Figure 4-6. - Using Boat Hook to Retrieve Survivor.

Figure 4-7. - Boat Hook Danger Zone.

As the survivor arrives alongside the platform, report, "MAN AT PLATFORM." When you have the survivor on the platform, report, "MAN ON PLATFORM." Bring the survivor quickly in the cabin and report, "MAN IN CABIN, GOING OFF HOT MIKE." After the cabin is secured and all hands are secured, report, "CABIN SECURED, READY FOR FORWARD FLIGHT." Because of the minimum danger, the pilot will normally remain on the water until the report of ready for flight is given. Whether the helo is on the water or in a hover, forward flight should not be attempted until you report that you are ready.

Figure 4-8. - Man on Platform.

Rough Water Recovery (Figures 4-9 through 4-11)

A rough water platform pickup is considered a hazardous maneuver. It should be considered only if a hoist cannot be carried out. If the pilot elects to make a platform recovery, the approach and preparation for the pickup is the same as for a calm water pickup. After establishing a hover, the pilot will instruct you to open the

Figure 4-9. - Rough Water Pickup.

Figure 4-10. - On the Water, Right 10.

door and lower the rescue platform. The pilot will position the helicopter so that the major swell is off the port bow to the port beam. The survivor should be at the 1 o'clock position, well outside the rotor wash. While maintaining this general relationship, the pilot will evaluate the sea again. If everything seems OK, the pilot will state, "GO ON HOT MIKE." You should go on hot mike and establish ICS communications. When the pilot is ready for the pickup, the command "CONN ME IN" will be given. At this time, you will begin giving continuous directional commands and advisory reports. When the helicopter closes in on the survivor and sea conditions permit, the pilot will land with the survivor just inside the rotor wash. During this phase, the copilot must alertly scan the sea to the port. Also, when landing crosswind in a sea state 2 or higher, rotor clearances will become critical.

Once on the water, guide the helo to the survivor. Remember the closure rate must be closely controlled to stop all drift as the survivor approaches the platform. When the survivor is alongside, report, "MAN AT PLATFORM." As soon as possible, pull the survivor onto the platform. When you and the survivor are safely on the platform, report "MAN ON PLATFORM, CLEARED TO HOVER." The pilot will establish a safe hover and turn the helo into the wind.

Figure 4-11. - Man on Platform, Cleared to Hover.

You should get the survivor into the cabin and report, "MAN IN CABIN, GOING OFF HOT MIKE." Secure the equipment and ensure all passengers are strapped in. Now report, "CABIN SECURED, READY FOR FORWARD FLIGHT." Again, the helo will not transition to forward flight until you are ready.

Commands and advisory reports should continue until the rescue is complete or the pilot directs, "CEASE COMMANDS." The cabin is secured when the strap is across the door, survivors strapped in, crew strapped in, and the platform in the helo and stowed. When stowing the platform, ensure that the platform support cables are secured with a bungee to prevent them from entering the tail rotor drive shaft housing.

APPROACH HAZARDS

It is dangerous to air taxi close to small boats or life rafts because the rotor downwash could capsize the raft or boat and possibly cause contact with the rotor blades. It is normally best to land short and, using minumum collective, water taxi for the recovery.

Use extreme care in approaching a parachute in the water. Avoid this if at all possible. When recovering an immobile survivor attached to a parachute, land the helicopter clear, to one side. You or another

Figure 4-12. - Rowing to Survivor.

crewmember will swim or use a raft to aid the survivor (figure 4-12). You should be attached to a safety line and don a life vest before attempting such a rescue.

When being approached by a small boat, the pilot and crew must be alert to take corrective action if it appears that the persons in the boat may stand up, raise oars, or in any way jeopardize themselves or the helicopter. Signal the people to keep low with a palms down motion with both hands.

Personnel Ladder (Figures 4-13 and 4-14)

Although the personnel ladder was not originally designed for use as a piece of rescue equipment, experience has shown that the ladder has very positive advantages over the rescue platform under certain situations. When you are recovering a mobile survivor, the personnel ladder acts like the ladder in a swimming pool. The ladder permits a person in the water to grab onto something and to climb out of the water into the aircraft with the crewmember's assistance. The crewmember, with the safety harness adjusted, may climb down several steps into the water and give the survivor considerably more assistance than when operating from the rescue platform. When you are recovering a body or an object, the rescue platform is recommended.

The decision of which piece of equipment to use, rescue platform or personnel ladder, is the aircraft commander's, based on the evaluation of the situation, safety, and your recommendations as a crewmember. The checklist and voice procedures are the same for either piece of equipment.

Figure 4-13. - Personnel Ladder.

Figure 4-14. - Using Personnel Ladder.

PHRASEOLOGY

As with the host operation, there are standard voice reports necessary to prevent confusion and misunderstanding. The reports fall into the same two catergories as discussed before: COMMANDS and ADVISORY REPORTS.

Commands

The same commands used for a hoist operation are used for a platform recovery. Remember that commands are given in reference to the fore-and-aft axis of the helicopter, and directional commands require a distance to be moved in feet. Listed is a command that has taken on a new meaning when applied to the rescue platform. All other commands carry the same meaning as discussed before.

UP — Immediate danger to the survivor or aircraft. Imediately establish a hover. May be given by the copilot if something is endangering the aircraft from the port side.

Advisory Reports

Advisory reports are used to keep the pilot informed of everything that occurs during the rescue. Due to the situation and the equipment used, most of the reports are different from those used for a hoist. The following is a list of the standard rescue platform advisory reports and their meanings.

RESCUE CHECK-LIST COMPLETE, READY FOR PLATFORM PICK-UP	Self-explanatory
ON HOT MIC, HAVE TARGET INSIGHT	Self-explanatory
MAN APPROACH-ING PLATFORM	The survivor is close to the platform, and the distance between the survivor and the platform is closing.
MAN ON PLAT-FORM	Self-explanatory. (calm water)
MAN ON PLAT-FORM, CLEARED TO HOVER	Self-explantory (rough water).
MAN IN CABIN, GOING OFF HOT MIKE	The hoist operator is going off hot mike and will be assisting the survivor and stowing the equipment.
READY FOR FOR-WARD FLIGHT	see page 3-12
CABIN SECURED	see page 3-12
MAN DRIFTING	Object or person is drifting into an area which may be potentially dangerous.

CARGO SLING

GENERAL (Figure 4-15)

The low response external cargo sling permits carrying loads up to 8,000 pounds beneath the helicopter. The sling is made up of universal sling fittings, cables, a cargo hook, pulleys, and a suspension frame. The sling is attached to four hard points on the bottom of the helicopter by four universal sling fittings. The fittings, in turn, are attached to a suspension frame, which contains a pulley in each corner. Two cables are threaded through the pulleys which support the cargo hook. Each cable picks up a suspension ring on the cargo hook, is threaded through a pulley, passes diagonally below the tub, and is threaded through the opposite pulley; the cable is then attached to the opposite suspension ring.

The low response feature permits the hook and load to swing independently of the helicopter in any direction. The path of the hook during its swing is elliptical. The hook and its load are allowed to reposition themselves during attitude changes. Thus, the weight remains close to the helicopter's center of gravity and eliminates undesirable aircraft reponses.

The 8,000-pound capacity hook contains an open throat load beam that supports the load during carrying operations. The beam is pivoted at the aft end and may be released electrically or manually. Ground personnel may open the hook by actuating the manual release lever located on the side of the cargo hook. The electrical release and emergency manual release are controlled from the helicopter. The load beam for the cargo hook will automatically return to the normally closed position after the load is released. For a pickup, the helicopter can be hovered over the load and the load attached to the hook from outside the heilocpter, or the load can be hooked to a preset ring by the pilot flying the hook into the ring.

Because of the external load, radio communications, navigation systems, and radio altimeter readings may be unreliable. The load may also cause a deterioration in the stability of the helicopter. The external load may cause oscillations to the extent that

the load may oscillate into the rotor blades and/or fuselage. The oscillations can usually be controlled by slowing the forward speed.

Any static electricity that may have been generated by the helicopter should be dissipated before attempting a hookup. Discharge the sling by allowing it to touch the ground or a conductor connected to ground.

OPERATING CONROLS (Figure 4-15)

Cargo Sling Master Switch

A switch, marked CARGO HOOK, is located on the overhead switch panel. The switch controls the operation of the cargo sling hook. The switch positions are marked AUTO, SAFE, and SLING. The SLING position energizes the thumb switches, marked CARGO, on the pilot's and copilot's cyclic stick grips. This switch allows the pilot or copilot to electrically release the load on the sling. The cargo sling master switch should be in the SLING position during cargo hookups and until a safe altitude and airspeed are reached. This position will allow for quick release of the external load if an emergency occurs.

The AUTO position energizes the cargo release switches and also a touchdown switch on the cargo hook. The touchdown switch, activated by load tensions greater than 125 pounds, will automatically release the load when the load touches the ground and the load tension on the hook becomes less than 100 pounds. After an AUTO cargo release, the CARGO HOOK OPEN light will blink continuously until the switch is positioned to SAFE.

Although the automatic touchdown release is set to actuate at 100 pounds or less, it should never be used with loads less than 200 pounds. The cargo sling master switch should never be in the AUTO position during flight. The hook would open immediately if a gust of air momentarily lightened the load. The AUTO postion should be used just before touchdown to avoid an inadvertent release of the cargo. The master switch should always be returned to the SAFE position and the sling stowed after the load has been released.

The master switch receives electrical power from the DC primary bus through a circuit breaker, marked CARGO HOOK POWER, located on the overhead circuit breaker panel.

Cargo Release Buttons

A cargo release button, marked CARGO, is located on the pilot's and copilot's stick grips. Either cargo release button may be depressed to open the cargo sling hook if the cargo sling master switch is in either the AUTO or SLING position.

Cargo Release Pedal

A cargo release pedal, located on the pilot's side of the cockpit, is connected mechanically by cable to the manual release lever on the cargo hook. The pedal may be depressed to mechanically open the cargo sling hook when the electrical release circuit is inoperative. The load will be released in the air or on the ground regardless of the position of the cargo sling master switch.

Cargo Hook Open Advisory Light

The cargo hook open advisory light is actuated by a microswitch on the cargo hook. A green advisory light, marked CARGO HOOK, is located on the caution-advisory panel. The light will come on whenever the cargo hook load beam is open.

Cargo Hook Manual Release Arm

Ground personnel may manually release the cargo hook by operating the manual release arm on the cargo hook. A force of 15 to 22 pounds is required to move the release arm, in an upward direction, to release a load of 8,000 pounds. With no load, 10 pounds of force is the maximum required to open the load beam.

Cargo Hook Stowage Line

The cargo hook stowage line runs from the cargo hook into the fuselage to a cleat close to the deck on the right-hand compartment side panel just aft of the cargo door. The cargo hook is stowed by lifting the cargo hook by the nylon line and tying the line to the tiedown cleat inside the cargo compart-

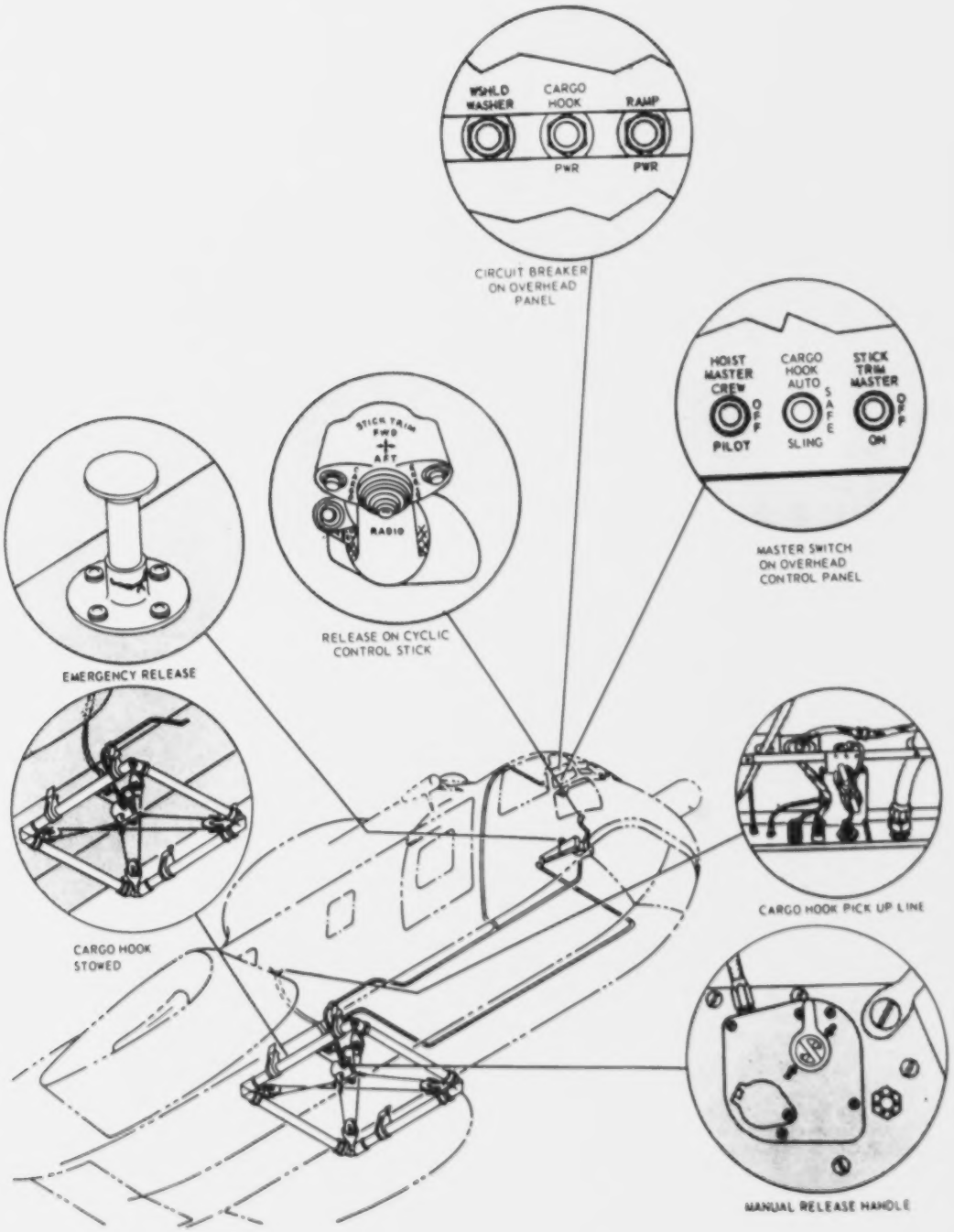


Figure 4-15. - Low Response Cargo Sling System.

ment. To release the cargo hook from the stowed position, untie the nylon line and slowly lower the cargo hook. A bungee cord, attached from the cargo hook cables to the fuselage, removes the slack from the cables when the hook is stowed.

OPERATION

The most important phase of a cargo sling mission is thorough planning. The operating area should be selected to avoid flight over vehicles, buildings, or congested areas and to provide optimum safety. Areas of dust, mud, snow, or ice should be avoided. All personnel concerned with the mission should be thoroughly briefed on their duties and responsibilities during the operation. The briefing should include but is not limited to the following items:

1. Cargo to be carried.
2. Operating area description and peculiarities.
3. Approach, hookup, and release methods.
4. Crew duties, air and ground, including comms, grounding, approach, and egress procedures.
5. Engine or equipment malfunction procedures.

Ground crew personnel should enter and depart the cargo sling hookup area from the starboard side of the aircraft. They should wear helmets with the visors down and radio cords tucked in. They must exercise sound judgment and common sense in positioning themselves so that if the load should be accidently dragged or lifted, they can move clear immediately to avoid injury. If an emergency occurs during cargo sling ground operations, the helicopter and ground crew personnel should move in opposite directions to clear each other. The helicopter should move to its left while ground crew personnel move to the right. Ground crew personnel should make every effort to work at the right side of the load (with respect to the position of the helicopter over the load). In an emergency, they can clear from under the helicopter without climbing over or moving around the load.

Preflight

The preflight inspection should include checking the following:

1. Security of the sling and attachments
2. Proper rigging of the manual release.
3. Security and condition of the cargo hook.
4. Check of mechanical and electrical operation on the cargo hook.

Pickup

During the approach, the sling should be checked to ensure it is fully extended and all cables and lines are clear. The pilot will select the SLING position with the cargo sling master switch and turn on the HOT MIC listen switch. The pilot will make the approach and when ready for instruction, will advise you, "CONN ME IN." Using standard voice hoist procedures, guide the helicopter to a position directly over the cargo. The ground personnel will enter the area from the right, ensure the static electricity is discharged, and assist as necessary in the hookup. You, the aircrewmember, must monitor the hookup and the activity of the ground personnel. When the hookup is complete, advise the pilot that you are ready to lift. The pilot will smoothly increase power until the cable is under tension and slowly continue power increase to lift-off. Report to the pilot when the cargo is clear of the deck. When the helicopter is in the hover, the load should be allowed to stabilize.

For training operations, a 10- to 15-foot cable should be attached to the selected load. The length of cable will vary in actual operation. Also, training loads are not to exceed 2,000 pounds.

Transition To Forward Flight

The pilot will transition to forward flight and establish a positive rate of climb. Acceleration and maximum speed will depend on the type of load being carried. To prevent oscillations, some loads require airspeeds below 10 knots. The helicopter should never be maneuvered abruptly. You must monitor the load for oscillations and other unsatisfactory indications.

After the helicopter reaches 500 feet above ground level, the pilot should switch the cargo master switch to "SAFE." When the switch is in "SLING," the pilot should exercise caution to prevent inadvertent release of the load. Gusty wind conditions, action of the load, or aircraft equipmet malfunction can cause or require unplanned load release.

LOAD STABILITY: Most of the problems in helicopter external lifts concern the instability of loads in flight since the sling load is seldom aerodynamically stable. Load instability will occur whenever the weight of a suspended load is not not sufficient to hold it down against the drag of the air through which it moves. Such loads will normally turn boadside to the direction of flight, thus exposing maximum drag surface. Such loads may be stabilized by one or more of the following means:

1. Reducing the airspeed.
2. Making slow control movements.
3. Increasing the weight of the load.
4. Reducing the drag surface by altering the relationship between the center of gravity and the center of pressure of the suspended load to assure that the narrowest surface points in the direction of flight.
5. Reducing the drag surface can be anchieved by adding more area to the rear of the load or adding weight to the front. The general rule is that stability will be assured at practical helicopter speeds when the load's center of gravity is located at the front third of the surface area.

CAUTION

Spinning may result in pendent failure. If conditions permit, a spinning load may be placed on the ground or water to reduce the spin rate. Release uncontrollable loads.

Delivery

As with the pickup, the aircraft should make a normal aproach to the delivery point. At the desired time, switch to hot mike. At 300 feet above the ground, the cargo master switch should be placed to "SLING." If used, the AUTO position should not be selected until the aircraft is over a safe drop area. When the cargo is on deck, report, "CARGO ON DECK." After the cargo is released, report, "RELEASED." Remember the sling must be stowed before landing.

SELF-QUIZ #4

1. Commands and advisory reports for platform pickups are required until the _____.

   A. pilot states, "CEASE COMMANDS," or the rescue is completed
   B. survivor is on the platform
   C. pilot states, "CEASE COMMANDS" only
   D. rescue is completed only

2. What is the BEST way to approach a small boat?

   A. High hover and descend over the top
   B. Land short and water taxi, using minimum collective
   C. Land long and water taxi, using maximum collective
   D. Low hover and approach quickly

3. What is the function of the cargo sling?

   A. Provides for hoisting many items at once
   B. Aids in the loading of heavy cargo
   C. Strengthens the main hoist for heavier loads
   D. Permits carrying loads beneath the helicopter

4. For automatic cargo hook operation, the hook will automatically open when the load tension on the hook is less than _____ pounds.

   A. 50
   B. 100
   C. 125
   D. 200

5. If an emergency occurs during a cargo sling ground operation, which direction should the helicopter and ground crews move to clear each other?

   A. Helo forward, crew aft
   B. Helo right, crew left
   C. Helo left, crew right
   D. Helo aft, crew forward

6. What is the purpose of the rescue platform?

   A. Allows a crewmember movement outside helo
   B. Provides an additional platform for hoist operations
   C. Recovers personnel when water landing can be made
   D. Serves as an emergency egress platform

7. The crewmember's harness is adjusted to allow complete freedom of movement to _____ of the platform.

   A. the middle
   B. the edge
   C. within 1 foot short of the edge
   D. within 1 foot beyond the edge

8. Which command is used when a survivor is in immediate danger from the helicopter?

   A. PICK UP INTO A HOVER
   B. EMERGENCY LEFT
   C. UP
   D. HOLD

9. How may the gound crews release the cargo hook?

   A. Electrically only
   B. Manually only
   C. Electrically or manually only
   D. Electrically, manually, or remotely

10. Which control (s) is/are activated when the cargo sling master switch is in the SLING position?

    A. Pilot's thumb switch only
    B. Copilot's thumb switch only
    C. Hoist operator's control switch only
    D. Pilot's and copilot's thumb switches only

11. What is the MAXIMUM weight allowed for a cargo sling training load?

A. 2,000 pounds
B. 4,000 pounds
C. 6,000 pounds
D. 8,000 pounds

12. For an actual pickup, the platform cables are rigged in _____ position.

A. the upper
B. the lower
C. the middle
D. any

13. When using the boat hook for rescue platform work, what safety precaution must you observe?

A. Do not extend the hook beyond 4 feet
B. Do not raise the hook above the heigth of the cargo door
C. Do not dip the hook in the water
D. Do not extend the hook aft of the sponson

14. When a survivor is drifting into a potentially serious danger area, which voice report is used?

A. MAN DRIFTING
B. PICK UP INTO A HOVER
C. UP
D. HARD LEFT

15. Cargo oscillations can be controlled by decreasing _____.

A. cargo weight
B. hauling altitude
C. fulcrum
D. airspeed

16. The cargo hook can be manually released from within the helicopter by _____.

A. pulling the release line in the cabin
B. pulling the release handle in the cockpit
C. depressing the release pedal in the cockpit
D. placing the release switch to the MAN position

17. What is the recommended altitude that the master cargo switch should be changed from SLING to SAFE?

A. 30 feet AGL
B. 300 feet AGL
C. 500 feet AGL
D. 1,000 feet AGL

18. The personnel ladder can be used as a rescue device when recovering a/an _____ from the water.

A. body
B. immobile survior
C. injured survivor
D. mobile survivor

19. During a calm water platform recovery, when will the pilot normally pick up into a hover?

A. Survivor on the platform
B. Survivor in the cabin
C. "GOING OFF HOT MIKE" reported
D. "READY FOR FORWARD FLIGHT" reported

20. For a rough water platform recovery, which voice report is used when the survivor is on the platform?

A. SURVIVOR ABOARD
B. MAN ON PLATFORM
C. MAN ON PLATFORM, CLEARED TO HOVER
D. HOVER, FLIGHT APPROVED

21. Before attempting a hook up or delivery during cargo operations, you should _____ for the safety of ground personnel.

A. discharge static electricity
B. set up in a high hover
C. shift control of cargo hook to ground
D. test emergency release

22. The master cargo sling switch should be in the _____ position during flight.

A. SLING
B. AUTO
C. OFF
D. SAFE

23. Which item will NOT increase the stability of an external load?

A. Reduce airspeed
B. Decrease weight
C. Make slow control movements
D. Reduce drag surface

24. What voice report is used when the pilot wishes to move in for a cargo pick-up?

A. GO ON HOT MIKE
B. COMM WE IN
C. CONNECT CARGO
D. GUIDE WE IN FOR PICKUP

25. The rescue platform will be rigged and the checklist completed when the _____.

A. helicopter lands on the water
B. pilot directs
C. target is in sight
D. hoist operator directs

26. For a rough water platform recovery, where should the survivor be when the helo is set down on the water?

A. Well outside the rotor wash at 1 o'clock
B. Just inside the rotor wash at 1 o'clock
C. Aft of the sponson at 5 o'clock
D. Just left of the nose

27. When is hot mike normally secured during rescue platform procedures?

A. Man at platform
B. Man on platform
C. Man in cabin
D. Cabin secured

28. What is the indication when a load has been automatically released from the cargo hook?

A. Audio tone
B. Caution light on steady
C. Caution light blinking
D. Tension indicator to 0

29. How should ground personnel manually released the cargo hook?

A. Pull tether line attached to hook
B. Move release arm up on side of hook
C. Pull "pip" pin at rear of hook
D. Remove the shackle attached to the load cable

30. When should the cargo sling master switch be changed from SAFE to SLING for delivery?

A. 100 feet AGL
B. 300 feet AGL
C. 500 feet AGL
D. Over a safe drop area

31. During a platform recovery, the aircraft makes an approach to a hover with the survivor at the _____ o'clock position.

A. 12
B. 1
C. 3
D. 10

32. When will the pilot normally pick up into a hover for a rough water recovery?

A. Survivor on platform
B. Survivor in cabin
C. Hot mike secured
D. Survivor at platform

33. During platform recoveries, when is the helicopter normally cleared for forward flight?

A. Man at platform
B. Man on platform
C. Man in cabin
D. Cabin secured

34. What is the MINIMUM weight that should be carried for automatic cargo hook operation?

A. 125 pounds
B. 200 pounds
C. 550 pounds
D. 600 pounds

35. Ground crews should enter and depart the cargo sling hookup area from the _____ of the helicopter.

A. nose
B. left side
C. tail
D. starboard side

36. When should the cargo sling master switch be placed in the AUTO position for an automatic delivery?

A. 100 feet AGL
B. 300 feet AGL
C. 500 feet AGL
D. Over a safe drop area

37. When is the rescue platform lowered for a calm water recovery?

A. Before approach
B. During approach
C. Before hover is established
D. After hover is established

ANSWERS TO SELF-QUIZ # 4

QUESTION	ANSWER	REFERENCE	QUESTION	ANSWER	REFERENCE
1	A	4-2	20	C	4-6
2	B	4-6	21	A	4-9
3	D	4-8	22	D	4-11
4	B	4-9	23	B	4-11 & 12
5	C	4-11	24	B	4-11
6	C	4-1	25	B	4-1
7	B	4-2	26	B	4-6
8	C	4-7	27	C	4-8
9	B	4-8	28	C	4-9
10	D	4-9	29	B	4-9
11	A	4-11	30	B	4-12
12	D	4-1	31	B	4-1
13	B	4-3	32	A	4-6
14	A	4-8	33	D	4-8
15	D	4-9	34	B	4-9
16	C	4-9	35	D	4-11
17	C	4-11	36	D	4-12
18	D	4-7	37	D	4-2
19	D	4-4			

HIGH-INTENSITY SEARCHLIGHT SYSTEM

Reading Assignment: 5
Pages 5-1 through 5-6

OBJECTIVES

To successfully complete this assignment, you must study the text and master the following objectives:

1. State the characteristics and the locations of the searchlight system's major components.
2. Explain the searchlight operation.
3. State the safety precautions for operating the searchlight.

DESCRIPTION

The high-intensity searchlight system (Night sun) provides a high-intensity light source particularly suited for most night operations, including search operations and examination of rescue locations from a safe altitude. Night photographic missions are possible by using daylight techniques and film.

The searchlight system is made up of the following components: external mount (gimbal mount and searchlight assembly), junction box, remote control unit, interconnection cables, and mounting hardware. (See figure 5-1.) The system uses the controllable searchlight position control switches for cockpit control of beam direction.

The searchlight system is powered by the DC primary bus. During the start sequence, 30,000 volts are generated within the searchlight assembly, and a high current power surge develops in the junction box. After the start sequence is completed, only 28 VDC are required for the system to sustain illumination.

EXTERNAL MOUNT (Figure 5-1)

The external mounting weighs 44 pounds and consists of three support brackets, the gimbal mount, and the searchlight assembly. The assembly is mounted on the port side of the helicopter below the avionicsman's window.

Gimbal Mount

The gimbal mounting assemgly consists of a yoke and two small DC motor actuators. One motor is mounted at the base of the yoke and rotates the light for azimuth. The second motor is mounted on one leg of the yoke and drives the trunnion mounting for elevation. Stop pins in the yoke bearing housing limit the searchlight rotation in azimuth. A slip clutch on each motor drive absorbs the motor torque when the searchlight is driven against the stop. The stops are adjustable in azimuth and may permit a maximum of 350 degrees of rotation. There are no physical stops for elevation. The normal range of elevation is from 10 degrees above the horizontal to 70 degrees below. The drive motors may cause some radio interference.

Searchlight Assembly (Figure 5-2)

The searchlight assembly consists of a cylindrical housing within which are mounted an arc lamp bulb, a reflector, a cooling fan, a focusing motor, and various electrical components used in the start circuit of the

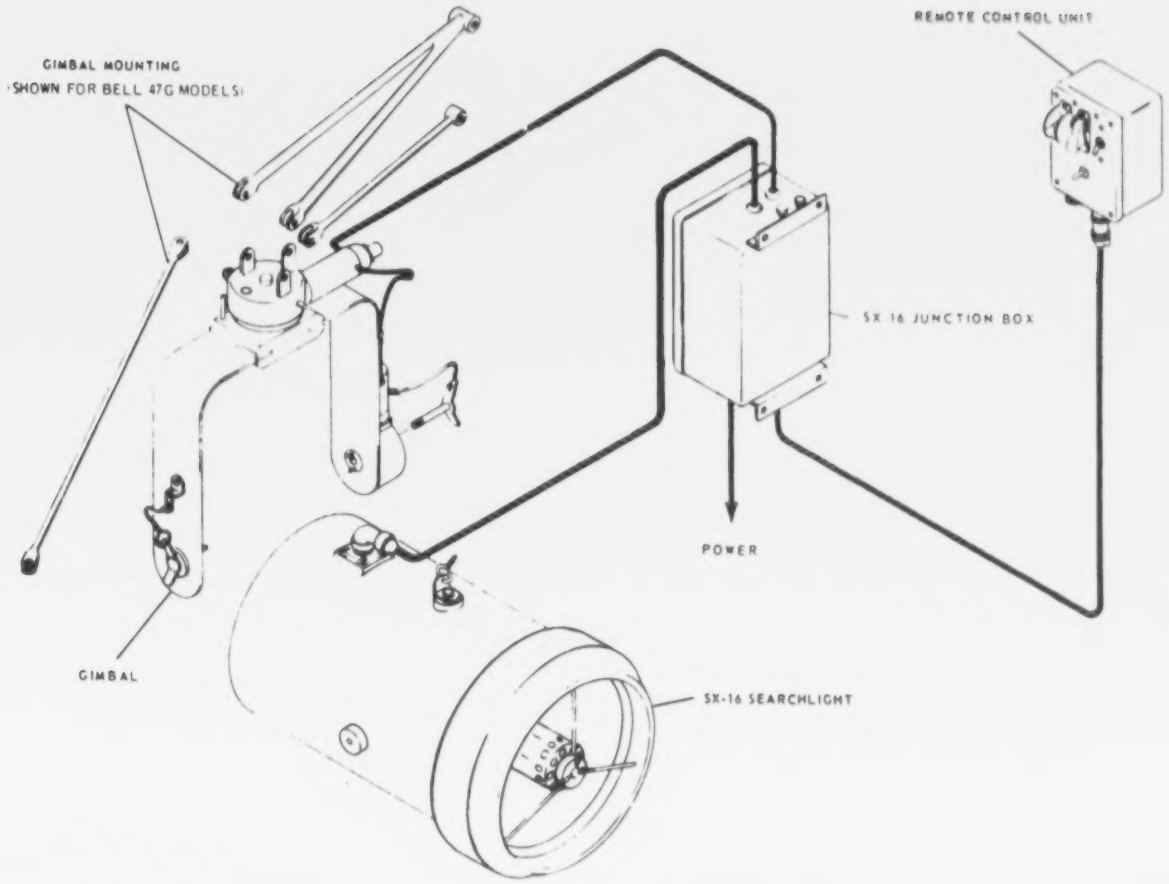


Figure 5-1. - Components of High-Intensity Searchlight System.

lamp. The lens, made of specially tempered glass, is capable of withstanding both mechanical stresses and high temperatures. The xenon arc lamp contains two tungsten electrodes permanently sealed in a quartz glass bulb filled with xenon gas under pressure. The lamp is capable of 3,800,000 peak beam candle power.

The pressure within an unlighted bulb is approxomately 75 psi. In a lighted bulb, the pressure approaches 300 psi, and the temperature surrounding the arc will range between 300°F. and 2,100°F. Should the bulb explode, it will be contained by the searchlight housing and lens.

The beam is focused by a focusing motor driving the reflector towards or away from the lens. The motor is nonreversing and continually drives the reflector back and forth through the same cycle. The focus is from a 10-degree beam width (FLOOD) to a 6.5-degree beam width (SEARCH). The searchlight assembly has a safety cable attached to the yoke.

JUNCTION BOX (Figures 5-1 and 5-3)

The junction box consists of a rectangular metal box containing relay and terminal connections for power distribution to the functional components for the searchlight equipment. The junction box is mounted

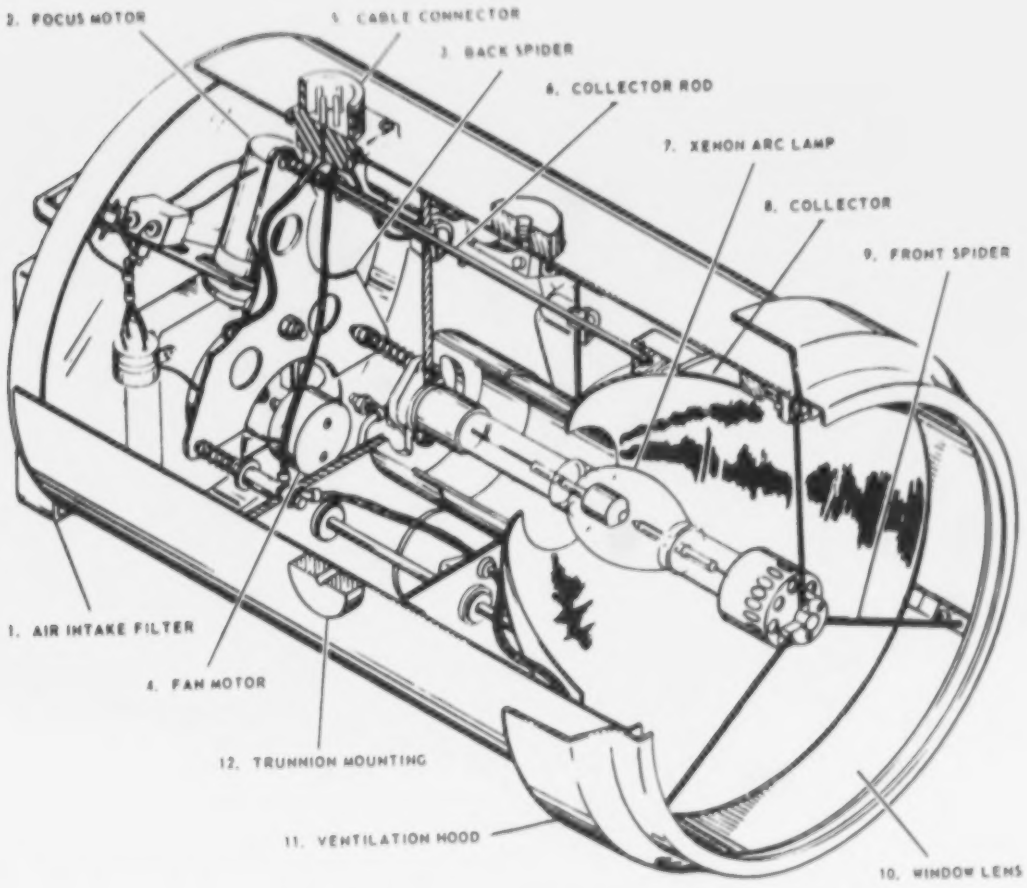


Figure 5-2. - Searchlight Assembly.

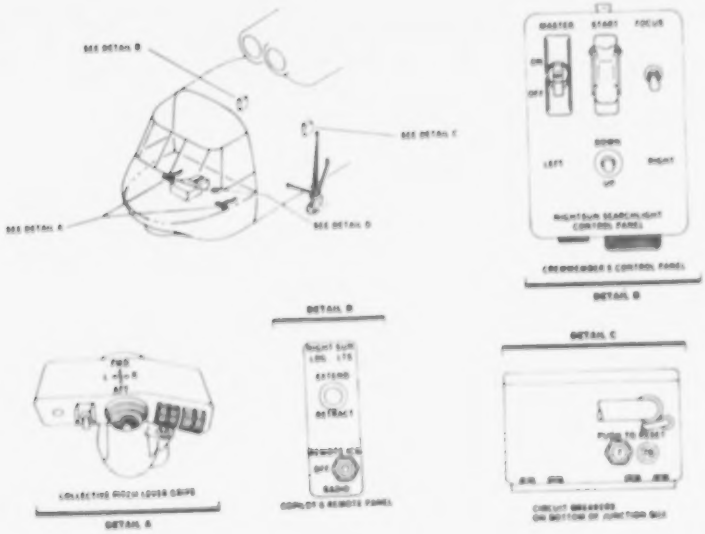


Figure 5-3. - Searchlight Controls.

in the cabin, port side, aft of the avionicsman's seat. Two circuit breakers are mounted on the bottom of the case (70A and 7A).

REMOTE CONTROL UNIT (Figures 5-1 and 5-3)

The control unit is monted in the cabin below the rescue hoist throttle control valve on the right side. Two quick-disconnect releases permit moving the unit to the other positions about the cabin for remote use. The control panel contains a circuit breaker-type ON-OFF switch, marked MASTER. This switch powers the lamp, lamp starter, gimbal drive motors, focusing drive motor, and a cooling fan in the lamp housing assembly. A guarded momentary contact switch, marked START, controls the start circuit. A third momentrary contact toggle switch, marked FOCUS, controls the motor-driven focus mechanism. A four-way momentary contact toggle switch, marked DOWN, UP, LEFT, RIGHT, controls the movement of the searchlight in azimuth and elevation. The above four switches are located on the face of the remote control unit. On top of the remote control unit is an unmarked momentary interrupt push button. This extinguishes the lamp but allows the cooling fan to continue running. The cooling fan runs anytime the MASTER switch is ON.

OPERATION PROCEDURES

INSTALLATION (Figure 5-4)

1. Locate the three mounting brackets on the left side of the helicopter.

2. Mount the searchlight using three mounting bolts and elastic stop nuts.

3. Connect the control/power cable to the connector on the side of the helicopter.

4. Attach the two drain tube extenders.

5. Remove the searchlight lens cover.

PREFLIGHT

1. Check the lens for cleanliness. Do not touch the lens with your hands; smudges cause an uneven heating of the lens and subsequent cracking.

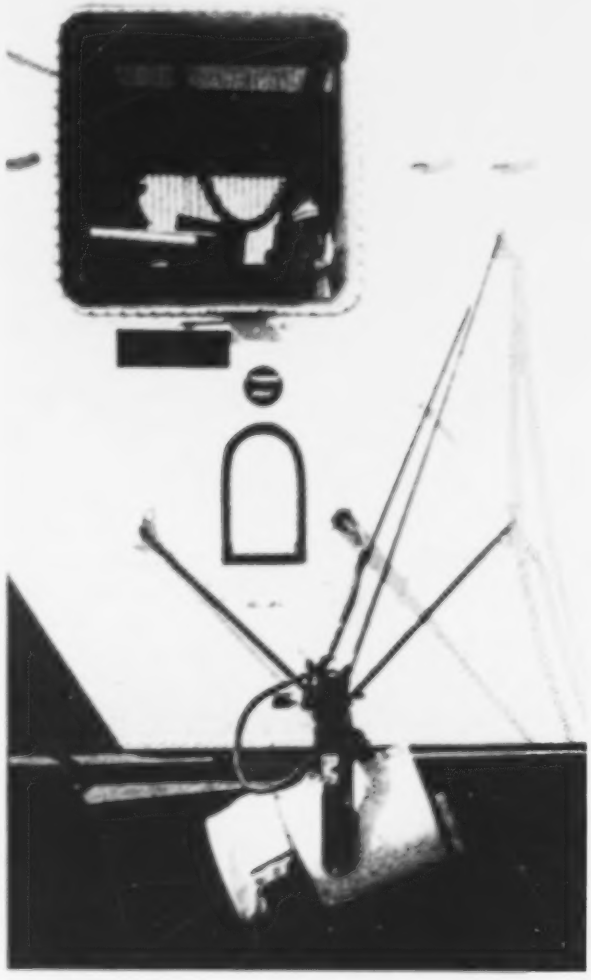


Figure 5-4. - Searchlight Installation.

2. Manually position the light so the beam will not strike the helicopter when the light is illuminated. Manual movement of the searchlight assembly will not damage the actuating mechanism.

3. Check the MASTER switch OFF.

4. Check the circuit breakers IN.

STARTING

The start sequence may cause considerable interference with the radios in the helicopter.

1. Turn the MASTER switch ON.

2. Depress the START switch until the lamp ignites (5-10 seconds). Release the switch immediately. Continuing to hold the switch depressed after ignition may seriously damage the searchlight.

OPERATION

1. Adjust the FOCUS switch to the desired beam width.

2. Operate the four-way directional control switch as desired.

3. When the controllable landing light is OFF or STOWED, the collective position control switches and the copilot's remote position toggle switch, on the remote ICS panel, control the Nightsun positioning.

SECURING

1. Depress the momentary OFF button. The lamp may be restarted, if desired, by pushing the start switch.

2. Allow 3 to 5 minutes for cooling.

3. Turn the MASTER switch OFF.

TECHNIQUES

Techniques for use of the searchlight must vary with the object of the search, area being searched, and meteorological conditions. General guidelines for the searchlights use are listed below; however, proficiency in its use can be acquired only through actual experience. The following techiques are only general guidelines for good search conditions:

1. Search airspeeds of 50 to 100 knots are recommended. The exact speed depends on the type of object being searched for and the area to be covered. The Nightsun has been designed to operate at airspeeds corresponding to helicopter limitations.

2. The search altitude should be proportional to the search object's size:

a. 1,000 to 1,500 feet for vessels or boats 40 feet or over.

b. 300 to 1,000 feet for boats less than 40 feet.

c. 300 to 500 feet for personnel. A hover search is also a satisfactory technique.

3. The beam width should be set as desired. Midway between narrow and wide beam width points provides a nearly solid beam spot.

4. The port side of the helicopter is the recommended search side and can be used efficiently by the copilot and avionicsman. The copilot can maintain directional control of the Nightsun with either the collective landing light control switch or the position toggle switch on the remote ICS panel. The avionicsman can start, focus, change direction, or secure the Nightsun by using the remote control box. The control box, mounted on the starboard side of the helicopter, has enough cable to allow it to be used in the avionics position.

The Nightsun should not be used to search on the starbord side of the helicopter because light may strike the helicopter.

SAFETY PRECAUTIONS

Observe the following safety precautions when operating the high-intensity searchlight:

1. Because of the high temperatures and high operating pressures, the possibility of an explosion is always present during the operation or handling of the bulb. An explosion or accidental breakage of the bulb could critically injure anyone within a radius of 25 feet. Wear eye protection and gloves at all times when cleaning the collector. Remove rings and watches before reaching toward the collector.

2. Beacuse of the high temperatures and peak beam candle power of 3,800,000, do not direct the searchlight toward personnel. Directing the searchlight toward personnel could cause critical eye damage up to 20 feet.

3. Avoid training the searchlight on any part of the helicopter. The heat gener-

ated is capable of melting a tire or igniting paint or fiberglass. When you are changing azimuth from side to side, avoid shining the light on or inside the helicopter.

4. The remote control unit can be operated from either the flight mechanic's or the avionicman's positions. The normal connection for the unit is by the flight mechanics seat. There is an additional power cord behind the avionicsman's seat. The remote unit must be plugged into the connection at the position inwhich it is being used. This eliminates the tripping hazzard in the cabin from the cable laying across the cabin floor.

5. Water landings with the searchlight installed shall be limited to operational necessities. If a water landing is neceasary and the searchlight is in use, if possible, turn the light off and allow it to cool before landing. Although three to five minutes are recommended, any cooling period is beneficial. The MASTER switch should also be secured before water contact. Water landings with any forward speed may cause damage to the Nightsun mounting and aircraft mounting points.

6. Do not attempt to operate the searchlight from battery power only.

SELF-QUIZ #5

1. What is the flood beam width of the searchlight?

   A. 3.2 degrees
   B. 6.5 degrees
   C. 10.0 degrees
   D. 20.0 degrees

2. Under what condition can the pilot or copilot control the searchlight position?

   A. The junction box's remote switch is in the remote position
   B. The cockpit searchlight's master switch is on
   C. The remote position toggle switch is not being used
   D. The controllable landing light is off and stowed

3. When you are using the Nightsun, what is the recommended search altitude for a boat over 40 feet?

   A. 100 - 300 feet
   B. 300 - 500 feet
   C. 300 - 1,000 feet
   D. 1,000 - 1,500 feet

4. Where is the external mount of the Nightsun located?

   A. Portside below avionicsman's window
   B. Portside aft of sponson
   C. Starboard side below cabin door
   D. Aft part of ramp

5. What is the search beam width of the searchlight?

   A. 3.2 degrees
   B. 6.5 degrees
   C. 10.0 degrees
   D. 20.0 degrees

6. For what period of time should the searchlight's fan run after the light has been extinguished?

   A. 1 - 2 minutes
   B. 3 - 5 minutes
   C. 5 - 10 minutes
   D. 10 - 15 minutes

7. An explosion of the Nightsun's bulb could critically injure anyone up to radius of _____ feet.

   A. 5
   B. 15
   C. 25
   D. 50

8. What is the searchlight's MAXIMUM azimuth rotation?

   A. 090 degrees
   B. 190 degrees
   C. 260 degrees
   D. 350 degrees

9. Where is the searchlight's junction box located?

   A. Aft of avoinicsman's seat
   B. Aft of flight mechanic's seat
   C. Forward of avionicsman's seat
   D. Below the hoist throttle valve

10. Which switch controls the searchlight's cooling fan?

    A. Master switch
    B. Internal lamp thermal switch
    C. External lamp thermal switch
    D. Start switch and interrupt button

11. The searchlight can cause critical eye damage up to _____ feet.

A. 5
B. 15
C. 20
D. 50

12. What is the normal elevation range of the searchlight?

A. Dead ahead (0 degrees) to 45 degrees down
B. 10 degrees above to 70 degrees below the horizon
C. 10 degrees below to 90 degrees below the horizon
D. 30 degrees below to 90 degrees below the horizon

13. Where is the searchlight's remote control unit located?

A. Below the hoist throttle control valve
B. Aft of the avionicsman's seat
C. Forward of the flight mechanic's seat
D. Forward of the avionicsman's seat

14. What is the recommended search airspeed using the nightsun?

A. 10 - 25 kts.
B. 25 - 50 kts.
C. 50 - 100 kts.
D. 100 - 125 kts.

15. Why should you avoid training the searchlight on any part of the helicopter?

A. Reflections make it difficult to see the water
B. Reflections induce vertigo
C. Refracted light distorts vision
D. Lamp heat melts the paint

16. What is the light source for the high-intensity searchlight?

A. Neon lamp
B. Incandescent lamp
C. Arc lamp
D. Ion vapor lamp

17. Where are the searchlight's control switches located?

A. Junction box (searchlights)
B. Remote control unit (searchlights)
C. Lower radio console (cockpit)
D. Collective pitch lever (pilots)

18. When you are using the Nightsun, what is the recommended search altitude for a person?

A. 100 - 300 feet
B. 300 - 500 feet
C. 300 - 1,000 feet
D. 1,000 - 1,500 feet

19. What is the peak beam candle power of the searchlight?

A. 1,400,000
B. 2,800,000
C. 3,300,000
D. 3,800,000

20. The searchlight's lighted pressure approaches _____ within the bulb.

A. 75 psi
B. 125 psi
C. 300 psi
D. 450 psi

21. When should the searchlight's start switch be released?

A. After 10 seconds have elapsed
B. When the fan starts turning
C. As soon as the light ignites
D. When the lamp temperature exceeds 800°F.

22. When you are using the Nightsun, what is the recommended search altitude for a boat under 40 feet?

A. 100 - 300 feet
B. 300 - 500 feet
C. 300 - 1,000 feet
D. 1,000 - 1,500 feet

23. What switch is used to extinguish the lamp under normal operation?

A. Master
B. Controllable landing light push button
C. Momentary interrupt button
D. Start

24. What is the MAXIMUM temperature surrounding the lamp of the searchlight?

A. 300°F.
B. 800°F.
C. 1,500°F.
D. 2,100°F.

ANSWERS TO SELF-QUIZ #5

QUESTION	ANSWER	REFERENCE
1	C	5-2
2	D	5-5
3	D	5-5
4	A	5-1
5	B	5-2
6	B	5-5
7	C	5-5
8	D	5-1
9	A	5-2 & 5-4
10	A	5-4
11	C	5-5
12	B	5-1
13	A	5-4
14	C	5-5
15	D	5-5
16	C	5-2
17	B	5-4
18	B	5-5
19	D	5-2
20	C	5-2
21	C	5-5
22	C	5-5
23	C	5-4 & 5-5
24	D	5-2

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